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| 13. ABSTRACT (Maximum 200 Words) This research uses secondary, longitudinal data to assess the physical, mental, social, and familial health status of Persian Gulf War/Desert Storm veterans (GWVs) relative to the health status of otherwise comparable groups of active military personnel. The sample included 565, largely married males with families, between 19-58 years of age. Most (72%) were white, 19% were black, and 9% were Hispanic or of other (or mixed) ethnicity. The majority were enlisted and served in the Army. At the time of baseline data collection, 25% had recently deployed to or returned from the Gulf; 15% had recently deployed to some other, noncombat region or returned from it; and 60% had not recently been deployed or returned. Analyses show that the demographic (e.g., age, education) and military (e.g., rank, branch of service) backgrounds of these groups did not vary significantly, thus any effects associated with deployment status are not likely attributable to such potentially confounding factors. Results identify two significant effects of Gulf deployment, both associated with family well being. Spouses of GWVs had significantly greater psychopathology than others, and the pile up of potentially stressing life events was significantly greater among the families of GWVs than of others. | | | | |
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Final Report:
Physical, Mental, Social, and Family Health Outcomes of Gulf War Veterans

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Introduction

This research builds on efforts to understand the multifaceted health consequences for Gulf War veterans (GWVs) who were deployed to Desert Storm, many of whom were exposed to an array of conditions with potential health implications^{1,2} and who have reported a variety of physical³ and psychological^{2,4-7} health problems associated with deployment.¹⁻³ Secondary, longitudinal data are used to assess the health of GWVs, and changes in their health, in four domains: physical, mental, social, and familial. Multivariate statistics are used to identify deployment-related effects, independent of the demographic, social, or military background of veterans. Further, analyses of moderating effects identify variables such as ethnicity that may protect some subpopulations of veterans from adverse health consequences or, conversely, place them at greater risk. Three active military groups are examined – those who deployed to the Persian Gulf, those who deployed to other (noncombat) regions, and those who did not deploy at all. Thus, health and health changes among GWVs are assessed in light of experiences of otherwise comparable groups, which much of the prior research has not been able to do.^{1,2} The capacity of troops to fulfill their duties depends heavily on their positive health and the well being of the loved ones they leave behind. The capacity of the military to meet the needs of its troops depends on information about the range of health problems veterans experience, the severity of these problems, and how problems manifest themselves over time. Results from this research can help inform military personnel and policy makers about resources and programs that may be needed or expanded to help veterans avoid or overcome any negative effects of combat-related deployment.

Background

A growing body of research on Gulf War-related illnesses suggests that veterans experienced a variety of negative physical and psychological health outcomes. Below, current literature on Gulf War illnesses, and limitations of the research, are discussed. Then, the proposed study is introduced, with attention given to how it overcomes limitations of past research and contributes to ongoing efforts to understand and address the health consequences of Gulf War deployment.

Current Literature

Nearly 700,000 troops were rapidly deployed to the Persian Gulf beginning in August of 1990 in response to Iraq's invasion of oil-rich Kuwait. While there, many troops were exposed to an array of numerous conditions with potential health implications.¹ Among these conditions were environmental exposures (e.g., chemical and biological weapons, pesticides) as well as a variety of psychosocial stressors (e.g., threat of missile attacks, guilt over leaving one's family). Since their return from the Gulf, a large number of veterans have reported a variety of physical and psychological health problems,² which have been associated with environmental exposures⁸⁻¹¹ as well as the various psychosocial stressors associated with deployment.^{1,3}

Two major efforts have been undertaken by the Department of Defense (DoD) to identify problems experienced by Gulf War veterans (GWVs) -- Virginia's Persian Gulf Health Registry and the Comprehensive Clinical Evaluation Program.² Studies based on each of these programs report similar findings, notably, that the same three diagnostic categories most frequently reported by veterans include musculoskeletal system diseases, psychological conditions, and symptoms and signs of ill-defined conditions.^{2,4} The most common psychological conditions reported include depression and anxiety (including post-traumatic stress disorder: PTSD), alcohol use or dependence, and medically unexplained physical-symptom syndromes.¹ While evidence has been insufficient to attribute adverse effects to a single *syndrome*, it has been consistent enough to infer that Gulf War exposure put veterans at risk for a variety of negative outcomes.²

Sampling Frame

While results of studies from programs such as the two mentioned above suggest a relationship between Gulf War exposure and negative health outcomes, the evidence is far from definitive. A variety of conceptual and methodological issues limit the utility of much of current research. Among them, is the use of select samples such as of veterans seeking assessment or treatment.⁵ While findings from studies of help-seeking veterans are informative, they cannot be generalized to the larger population of veterans who do not seek services. To overcome this problem, some research has been done with community samples of veterans. It, too, shows higher prevalence rates among GWVs of such problems as depression,^{3,5,6} anxiety,^{3,7} psychoticism;⁶ PTSD;^{1,3} alcohol abuse;⁷ and complaints about physical health and somatic problems.³ A meta-analysis of 11 published studies on Gulf War-related illnesses supports findings that show adverse health effects related to Gulf War deployment.² Additional research, based on samples more representative of the larger pool of veterans deployed to the Gulf, is needed to address questions about the prevalence or nature of problems they experienced. The proposed study is based on a relatively large sample of Gulf War veterans who had not self-selected themselves for treatment.

Data Source

Another issue relates to the source from which information about veterans' health is obtained. For example, while findings show a relationship between Gulf War deployment and negative health when veterans' self-reports are used, findings are less consistent when other data sources are used, such as lab results and physical findings.² To date, it remains unclear whether objective data sources are superior to self-report, however.¹¹ Relatedly, a meta-analysis¹² of nearly twenty studies of PTSD among GWVs finds that stress-related symptoms (of PTSD) may represent false-positive errors of measurement. False positives result when psychometric cutpoints on standardized instruments with known levels of measurement error (e.g., rates of sensitivity and specificity) are used to assess psychopathology rather than diagnostic clinical interviews. Once these sources of measurement error are taken into account, prevalence rates of PTSD in most of the studies reviewed fall to zero. Findings from these meta-analyses are significant and suggest that different data sources render different results. They also suggest the usefulness of obtaining data from a variety of sources, and in a variety of ways. While self-reports from veterans have been and will likely remain an important piece of the research agenda, there is a need for studies based on alternate sources of information.^{2,5} The proposed study is based on data obtained from the spouses of military personnel. Spouses are considered knowledgeable informants on the types of health issues their families or partners may have faced as a result of Gulf War deployment.

Comparison Groups

A key issue regarding research on Gulf War illnesses is whether the problems reported by veterans differ appreciably from those of others, particularly, of other comparable groups of active military personnel.² Unfortunately, a good deal of current research has been based solely on Gulf War veterans, without any other group with which to compare and assess their health reports.^{1,2} When comparison groups have been included, they have been of other military personnel deployed to noncombat zones,⁵ other personnel not deployed at all,⁶ or some other group not clearly defined.³ Evidence suggests that routine deployments,^{13,14} as well as absences unrelated to deployment, but which are common in military life¹⁵ can create significant stresses, such as separation from family and friends, disrupted routines, and loss of income.¹⁶ Without appropriate comparison groups, it is impossible to say whether or how any adverse effects of Gulf War deployment may differ from those experienced by other personnel deployed but not to combat zones, or by personnel unaffected by deployment but frequently mobile as part of their routine duties. The proposed research includes two comparison groups – those deployed, but not to the Persian Gulf (“Other Deployed”), and those not deployed at all (“Not Deployed”). This inclusion of multiple, clearly defined comparison groups can help clarify current understanding of whether and how war-zone deployments differ from other types of deployment as well as from routine military activities with regard to the health status of Gulf War veterans.

Scope of Outcomes

Another central issue not adequately addressed in the literature has to do with the scope of outcomes assessed.² Most research on Gulf War veterans has focused rather exclusively on a relatively narrow band of physical and psychological outcomes for veterans. However, evidence suggests that the effects of deployment can be significantly more far-reaching. For example, combat-related deployment has been associated with lost work productivity,⁵ substance abuse,^{17,18} lower post-military educational attainment;¹⁹ arrests;^{17,19,20} and anti-social activities.²¹ Research that addresses *social outcomes* such as these helps to broaden current thinking about the effects of Gulf War deployment and facilitates the specification of ways in which veterans may have attempted to cope with readjustments after the war.

The scope of outcomes can also be broadened by including assessments of the multiple effects deployment can have on the families of Gulf War veterans.¹⁶ Families affected by deployment are exposed to repeated, cumulative stressors that begin with the news that loved ones are leaving and continue through and beyond their efforts at post-war readjustment.^{16,22,23} Disruption of family routines, role confusion, concern over children's adjustment, loss of emotional support, decreased health care benefits or income, worry that the war would change the service member, distrust among spouses because of prolonged absence, pressure to return to normalcy, and having to catch up on decisions postponed because of absence are but a few of the many issues that families affected by deployment face.^{13,16,24} The number and range of family stressors has led some^{25,26} to suggest that families may have been more traumatized by deployment than the veterans themselves, with many Gulf War families experiencing what has been called *secondary traumatic stress*.¹⁶ Data also suggest that hardships associated with separation from family and friends were also significant for the veterans themselves, who have been more likely to rank family concerns than even fear of missile attack or death as their most significant source of stress while deployed in the Gulf.^{3,6}

While research on family outcomes is limited, Gulf War deployment has been empirically linked to a number of adverse family outcomes, including adjustment problems;^{16,23} diminished family cohesion;¹³ marital distress;^{21,23,27} clinically-significant levels of family distress;²³ higher levels of stressful life events;^{15,27} heightened symptomatology of the caregiver who remained at home;^{27,29} and elevated psychopathology among veterans' children.^{13,27} On the other hand, some evidence suggests that while a substantial minority of Gulf War families experienced very real difficulties, most did not experience severe systemic breakdown.²³ Research that focuses specifically on outcomes for veterans' families can add considerably to current efforts to identify and understand the full range and complexity of deployment-related health outcomes for veterans. Moreover, the need for assessments of family outcomes seems particularly warranted given reports that family adjustment directly influences soldiers' combat readiness, retention, and overall effectiveness.³⁰ In general, research that expands the scope of deployment-related outcomes is needed.³ This research responds to this call by examining social and familial health outcomes as well as physical and mental health outcomes for GWVs.

Analytical Model – Mediating and Moderating Effects

A central issue in understanding Gulf War-related health outcomes is whether factors other than deployment to the Gulf can account for any negative outcomes observed. A variety of variables have been associated with deployment status or combat exposure as well as with adverse health effects typically attributed to deployment, including age;^{6,31} ethnicity;⁶ educational attainment;³¹ rank;^{6,31,32} branch of service;⁶ satisfaction with military life;³³ socioeconomic status;^{32,33} and marital status.⁶ Similarly, variables such as those just cited have also been associated with negative family outcomes. For example, marital adversity in Gulf War families has been associated with age, education, and income,²¹ as well as with deployment.

In short, the effects of deployment on many of the outcomes of interest can be interwoven with or mediated by other variables associated with veterans' demographic, social, and military background. Unfortunately, some current research is descriptive only and, consequently, cannot assess the effects of deployment on health independent of the effects of other variables. Studies of psychological outcomes among Gulf War veterans that have controlled for other relevant variables suggest that, while background variables such as rank and age account for some of the negative health effect observed, the main effect of deployment, while weakened, persists.⁶ In general, however, studies that apply appropriate statistical controls when needed for confounding effects of other variables are lacking.¹⁵ In the absence of research that uses multivariate analytical models, the question of whether Gulf War deployment had a significant impact on veterans' health beyond that, or independent of, the effects of other factors cannot be addressed. This study includes multivariate analytical models that can control for confounding effects on health outcomes of variables other than deployment.

Relatedly, analytical models are lacking that can test for the presence of *interaction*, or *moderating effects*; that is, whether any effect of deployment on veterans or their families depends on some other factor. For example, some researchers have found a greater prevalence of psychological distress, such as depression;³ PTSD;¹⁹ and dissassociative disorders³⁴ among nonwhite veterans than among white veterans. This suggests that the effects of Gulf War deployment may have depended in some measure on veterans' race or ethnic background. Ethnic differences in health outcomes have been attributed to a variety of factors, including ethnic differences in combat exposure, test-taking attitudes, and preexisting conditions; perceptions among nonwhites that they must over-report symptoms in order to receive services from a predominantly white medical establishment; cultural differences in tolerance for health symptoms;

and racial discrimination.^{19,35} Few studies have examined ethnic differences in symptom reporting among combat veterans or, in particular, among Gulf War veterans, and their findings are inconclusive.³⁵

Variables other than race have put some groups of veterans at greater risk for negative health outcomes than others. Years of military service, rank, and socioeconomic status;^{15,32} social supports for families;¹⁶ and household size¹³ are other variables that may either put some groups of veterans or their families at greater risk of negative effects or, alternatively, buffer them from negative effects associated with Gulf War deployment. For example, families with stronger or more numerous social supports may be able to compensate for the absence of their military member better than families more isolated from support mechanisms. Veterans (or families) with more years in the military may have had more time to develop strategies for coping with the multiple stressors deployment can create. Thus, adverse outcomes for them may not be as many, severe, or long lasting as those for veterans with less military experience. Research that includes analyses of moderating variables helps to identify specific conditions that put particular groups of veterans (or families) at greater (or less) risk of any adverse effects of deployment. Analytical models developed for this study include interaction terms that enable the identification of variables that may either buffer or aggravate deployment-related effects on the physical, mental, social, or familial health of GWVs.

Time Frame

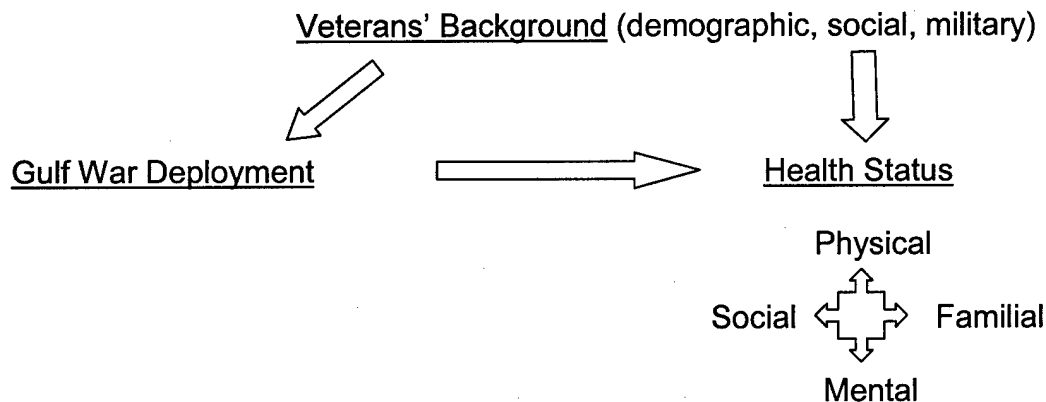
A good deal of current research on Gulf War-related health outcomes has been cross-sectional, with outcomes assessed at a single point in time.²¹ Few studies have followed GWVs over time to assess outcomes or problems (e.g., substance abuse) that may manifest when readjustment does not go well.³⁶ Some assessments have been made within a year of the veterans' return,³ while others have been made nearly twenty years after military service.³⁷ Some³⁸ suggest that delay in assessment may render more valid reports of the effects of trauma, while others³⁶ note that time may tend to attenuate symptom reporting, though perhaps not the symptoms themselves. It may be that negative combat-related outcomes "evaporate" over time, with any persistent problems attributable to conditions existing prior to deployment.³⁰ Limited data suggest that children's psychopathology diminished significantly in time after their fathers returned from peacetime deployments, though, outcomes did not appreciably change for children with fathers who deployed to the Gulf.¹³ Female partners of veterans have been found to experience more difficulties after the news of deployment than after the return.¹³ Little of current research has taken a longitudinal approach to assess whether, how, and to what degree outcomes may change over time. The proposed research is based on longitudinal data that enable assessments of outcomes over time. Specifically, questions about whether health has changed, what aspects of health have changed, how much change has occurred, whether changes follow any pattern, and whether the changes among GWVs differ appreciably from those of other era veterans are addressed.

Summary

Current literature on Gulf War-related illnesses is limited by select samples of help-seeking veterans, data based on veterans' self-reports, lack of multiple or clearly defined comparison groups, lack of analytical models that can assess mediating or moderating effects of other variables, narrow scope of outcomes assessed, and lack of longitudinal models that can assess change in outcomes over time. Other problems cited in the literature include small sample sizes of troops,² often from single units. This study overcomes some of the limitations of prior research. It

focuses on a relatively large number of military personnel, not in treatment, from three bases in the U.S. that had among the highest number of troops deployed to the Persian Gulf – Fort Campbell, KY, Fort Stewart, GA, and Fort Bragg, NC.⁴⁰ Two comparison groups, personnel who deployed to noncombat locales and those who did not deploy, are included, which provides context for assessing outcomes of GWVs. The scope of outcomes is broadened to include four domains of health: physical, mental, social, and familial. Data are obtained from veterans' spouses, who are considered knowledgeable about the kinds of health issues addressed in this research and who provide an alternative source of data to which studies utilizing other data sources can be compared. The analytical plan includes multivariate analyses that can identify the degree to which demographic, social, or military-related variables may either mediate or moderate the relationship between Gulf War deployment and health outcomes. Finally, multiple health assessments are made by which to assess whether, how, and to what degree adverse outcomes associated with Gulf War deployment change over time. The conceptual model below summarizes the proposed research. Gulf War deployment is hypothesized to have multiple effects in four domains of health (which may themselves interrelate). Veterans' background is thought to mediate and moderate the effects of deployment on health.

Model of Health Outcomes for Gulf War Veterans



Technical Objectives

| Research Objective | Technical Objective |
|---|--|
| 1. to describe the physical health of GWVs and assess whether it differs appreciably from that of other era veterans. | <p>What proportion of GWVs experience:</p> <ul style="list-style-type: none"> ▪ poorer general health ▪ serious disability ▪ cardiovascular disease ▪ chronic illness ▪ HIV/AIDS ▪ cancer <p>Are GWVs more likely to experience physical health problems than others and, if so, which ones?</p> |
| 2. to describe the mental health of GWVs and assess whether it differs appreciably from that of other era veterans. | <p>What proportion of GWVs experience:</p> <ul style="list-style-type: none"> ▪ depression ▪ psychosis/schizophrenia ▪ alcohol abuse ▪ drug abuse ▪ inpatient services for emotional/A&D problems ▪ outpatient services for emotional/A&D problems ▪ medication for emotional/A&D problems <p>Do GWVs experience more mental health problems than others and, if so, which ones?</p> |
| 3. to describe the social health of GWVs and assess whether it differs significantly from that of other era veterans. | <p>What proportion of GWVs experience:</p> <ul style="list-style-type: none"> ▪ arrests ▪ convictions/punishments ▪ probation ▪ imprisonment/other corrections <p>Do GWVs experience more social problems than others and, if so, which ones?</p> |
| 4. to describe the familial health of GWVs and assess whether it differs appreciably from families of other era veterans. | <p>What proportion of GWVs experience:</p> <ul style="list-style-type: none"> ▪ poor family functioning ▪ limited family resources (material and nonmaterial) ▪ life stressors ▪ marital distress <p>Do GWVs experience more familial problems than others and, if so, which ones?</p> |
| 5. to assess overall functioning and complexity of outcomes across the four health domains and assess whether that of GWVs differ significantly from that of other era veterans | <p>Do GWVs experience a greater number of problems across domains (physical, mental, social, family) than other era veterans?</p> <p>Do GWVs experience problems in more domains than others?</p> |
| 6. to describe changes in outcomes among GWVs (within and across four domains) and assess whether changes among GWVs differ significantly from those of other era veterans | <p>Do the number or types of problems experienced by GWVs change over time?</p> <p>What are the patterns of change in problems over time; for example, is there continuous improvement; immediate improvement with subsequent stabilization; or initial improvement, with subsequent decline?</p> <p>Do changes among GWVs differ significantly from those of others in number, type or pattern?</p> |
| 7. to assess whether health outcomes across domains and over time are mediated by demographic, social, or military profiles of GWVs | <p>Is the effect of Gulf deployment on outcomes or changes in outcomes mediated by variables, e.g.:</p> <ul style="list-style-type: none"> ▪ demographic (e.g., age), ▪ social (e.g., ethnicity, socioeconomic status), ▪ military (e.g., rank, branch) |

| | |
|---|---|
| 8. to assess whether health outcomes across domains and over time are <i>moderated</i> by demographic, social, military, or family profiles of GWVs | Do effects of deployment on health outcomes, or on changes in outcomes, vary by particular demographic, social, military, or family characteristics of GWVs? Examples: Do veterans of color experience different outcomes (or changes in outcome) than white veterans? If so, in what ways and to what degree? Do veterans with stronger family supports experience better outcomes (or changes) than those with weaker family supports? |
|---|---|

Methods

Study Design

The proposed research is based on secondary data collected through a longitudinal study (The Fort Bragg Evaluation Project: FBEP)⁴¹ of military families affiliated with Fort Bragg, NC, Fort Stewart, GA, and Fort Campbell, KY. Data collection began in the Fall of 1990, coincidental to early deployments to the Persian Gulf, and continued through 1997. The focus of the original study was on the effectiveness of mental health services for military dependents with behavioral or emotional needs. About 60% of participating families reported that the parent's deployment to the Gulf, or his/her recent return from the Gulf, had created behavioral or emotional problems for their child, which led them to seek professional help.

In the process of collecting extensive data on the child in treatment, data were also obtained on the physical, mental, social, and familial health of the family member in the military. Typically, information was collected through face-to-face and phone interviews with the veterans' spouse because many veterans had already deployed to the Gulf (or elsewhere) at the time of initial data collection. Following the initial interview, families were contacted three additional times, roughly six months apart, then three more times roughly one year apart for an abbreviated interview.

Data Source

Prior research has typically relied on veteran self-reports.² This research offers an alternative data source by using reports obtained from spouses of military personnel, many of whom were deployed (e.g., to the Gulf) at various points during data collection for the original study. Spouses are considered *knowledgeable informants* about the physical, mental, social, and familial health of their military member for several reasons. First, reliability of reports is a function of the observability of the outcome in question.⁴² Most of the outcomes addressed in the proposed research are likely observable by the spouse, for example, alcohol or drug use (mental health); arrests (social health); and physical disabilities (physical health). Too, they are able to observe symptoms across a range of contexts on repeated occasions. Data on the family domain of health may be best obtained from the spouse/mother, who tends to be the center of the household and principally responsible for identifying and responding to the health needs of the family. This is especially true in military families where the husband is frequently away from home.¹⁴ Moreover, spouses can provide information when subjects (e.g., veterans) are reluctant or unable to reveal health concerns because of fear of reprisal from the military.¹⁶ Too, empirical evidence suggests that spouse reports of depression⁴³ and of PTSD^{44,45} have a moderately high level of reliability and can be used with some confidence, with agreement not affected appreciably by either the degree to which the veteran verbally discloses symptoms⁴⁵ or on marital satisfaction.⁴⁴ In short, spouse reports are considered valuable given the observability of the health issues addressed, the need for alternative sources of data, and the integral role spouses/wives generally play in the military

family system. Their reports supplement data obtained from other sources and provide an alternative context in which other research, using other data sources, can be assessed.

Sample

The sample includes 565 active military personnel, 26% of whom had been deployed to the Persian Gulf during Operation Desert Storm (ODS). As stated above, the original study from which data for this research were based was the FBEP.⁴¹ Because some readers of this report may be familiar with the FBEP, we want to highlight a few differences between the original FBEP sample and the one used here. The FBEP included a larger group of families than is the focus of the present study. First, in the FBEP, families could include a head of household who was retired or discharged from the service; they did not have to be active duty, which is a requisite for the present study. Second, the FBEP required that the family be eligible for CHAMPUS benefits, but not that the CHAMPUS sponsor live in the target household. This situation arose when, for example, a wife had remarried a nonmilitary man and the former military husband (and CHAMPUS sponsor) lived in a separate household. Because our interest here is on the military family, we restrict this sample to those families where the active, military sponsor lived in the target household and for whom reports of their personal and familial health status could be considered reliable.

An additional criterion for inclusion in the present study emerged during preliminary analyses. Among the eligible families with an active military person living in the home, there were some (about 18%) whose composition changed over the course of data collection, for example, as a result of divorce and remarriage. Because the present study addresses change over time in health status, we wanted to assure that any personal health status reported was about the same, active military person and that any family health status reported was about the same family unit. To that end, the present study is based on those 565 active military families who were relatively "intact" during the course of data collection.

Table 1. Comparison of "Intact" Sample and Excluded Active Military Families with Changing HH Membership

| | Sample | Families w/ HH Changes |
|--------------------|--------|---------------------------|
| Gender | | |
| Male | 95% | 40% |
| Race | | |
| Black | 19% | 17% |
| White | 72% | 65% |
| Other | 9% | 18% |
| Age | | |
| 20-29 yrs | 25% | 22% |
| 30-39 yrs | 59% | 65% |
| GT 40 yrs | 16% | 13% |
| Education | | |
| H.S. grad/equiv. | 29% | 39% |
| Some college/2-yrs | 51% | 43% |
| College grad | 10% | 16% |
| Post-college | 10% | 2% |
| HH Income | | |
| LT \$20,000 | 31% | 23% |
| \$20-30,000 | 40% | 41% |
| \$30,000 + | 29% | 36% |
| Rank | | |
| Enlisted | 86% | 85% |
| Warrant Officer | 6% | 8% |
| Officer | 8% | 7% |
| Branch of Service | | |
| Army | 91% | 97% |
| Air Force | 8% | 3% |
| Other | 1% | 0 |

Table 1 shows the distribution on background variables for the study sample and those families excluded because of changes in heads of household. The percentage of families headed by a male is significantly greater in the sample (95%) than among those excluded because of household changes (40%). In changing households, the gender of the head of household would be expected to change more frequently as it shifts back and forth between female and male (e.g., when a divorced, female head of household remarries). The sample also differs somewhat from changing military households by ethnicity. A greater proportion of changing households were

Hispanic or of ethnic backgrounds other than white or black; although, the vast majority (80%-90%) across the board are either Black or White. Too, the sample is somewhat more highly educated than those excluded. Otherwise, excluding households with membership changes had no impact on its composition in terms of the age, rank, or branch of service of the military person, or the household's annual income.

Sample Representativeness

Table 2 shows the distribution on demographic, social, and military background variables among GWVs from the study sample and from the larger population deployed to the Gulf during the first year of ODS.⁴⁶

GWVs from the sample are very similar to the population with regard to gender, race, and rank. Differences between the two groups are most pronounced with regard to age, educational attainment, and branch of service. Unlike the GWV population, nearly all GWVs in the sample are married, reflecting the original study's focus on military families with children. The sample also tends to be older and more highly educated than the larger population, which likely reflects the family status of the current sample as well. Educational differences between the sample and population may also reflect differences in coding. The coding scheme for the population data seems to require completion of two years of college such that those with some college, but less than the two years would be coded in the previous category, "high school graduates." The coding scheme for the sample, on the other hand, allows for a category of participants with "some college," which could be less than two

years. Thus, the proportion with high school degrees in the study sample would be larger and closer to that of the population had this category not been offered to the study sample. Finally, Army personnel are overrepresented in this sample, though the three military bases from which the sample was drawn (Fort Campbell, Fort Stewart and Fort Bragg) deployed more troops to the Persian Gulf than nearly any other base in the U.S.⁴⁰ In sum, the study sample closely resembles the larger population of those deployed to the Gulf in several key ways, though, because of its focus on military families, it underrepresents younger and single veterans, as well as those who served in the Navy or Marines.

Baseline Comparisons of the Military Groups

As noted earlier, studies of GWVs are strengthened when they can include other military groups to which health outcomes for GWVs can be compared. This study includes data on two other active military groups – those who had deployed to other, noncombat regions of the world and those who had not deployed at all. Too, data are available on the location and dates of deployment, which enabled analysis of questions related to the duration, timing, and dangerousness associated with deployments. These data offer a unique opportunity to assess

Table 2. Representativeness of the GWVs

| | Sample | Population |
|-------------------------|--------|------------|
| Gender | | |
| Male | 99% | 94% |
| Race | | |
| Black | 20% | 23% |
| White | 70% | 70% |
| Other | 10% | 7% |
| Age | | |
| 18-29 yrs | 25% | 74% |
| 30-39 yrs | 59% | 22% |
| GT 40 yrs | 16% | 4% |
| Education | | |
| H.S. grad/equiv. | 35% | 93% |
| Some college/2-yrs | 46% | 2% |
| College grad | 11% | 8% |
| Post-college | 8% | 3% |
| Rank | | |
| Enlisted | 86% | 90% |
| Warrant Officer | 7% | 1% |
| Officer | 7% | 9% |
| Branch of Service | | |
| Army | 90% | 46% |
| Air Force | 9% | 12% |
| Other (e.g., USN, USMC) | 1% | 42% |

whether health, or changes in health, experienced by GWVs differ substantially from that of other era veterans and, if so, what the nature and degree of those differences are.

Table 3 shows data for five groups. A fourth of the sample either had deployed to the Gulf (15%) or recently returned from it (10%) before the first wave of data collection. Another 15% either had deployed to some noncombat region (7%) or recently returned from one (8%). The other 60% were not deployed, nor had they recently returned from any deployment at baseline. The last column shows that the sample overall included mostly white males, between 30 and 39 years of age, with some college education. Most had an annual household income between \$20,000 and \$30,000 per year. The vast majority was enlisted in the Army. Chi-square tests for statistical significance suggest that the groups varied at baseline on only one factor -- gender. A larger proportion of those who had recently deployed to the Gulf (99%) were male compared to the other groups. However, the vast majority across all groups was male. These nonsignificant differences strengthen the ability to attribute any differences in health status observed across the groups to deployment status rather than to potentially confounding factors such as those related to demographic or military background.

| Table 3. Social and Military Background By Deployment Status at Baseline (N=565) | | | | | | |
|---|--------------------|---------------------|---------------------|---------------------|---------------------|-------|
| | Not Deployed (60%) | Other Deployed (7%) | Gulf Deployed (15%) | Other Returned (8%) | Gulf Returned (10%) | Total |
| Gender | | | | | | |
| Male | 93% | 95% | 99% ^a | 96% | 100% | 95% |
| Race | | | | | | |
| Black | 20% | 19% | 20% | 16% | 19% | 19% |
| White | 74% | 70% | 70% | 69% | 71% | 72% |
| Hispanic/Other | 6% | 11% | 11% | 16% | 10% | 8% |
| Age | | | | | | |
| 20-29 yrs | 25% | 22% | 26% | 24% | 25% | 25% |
| 30-39 yrs | 58% | 70% | 62% | 56% | 53% | 59% |
| Over 40 yrs | 16% | 8% | 12% | 20% | 22% | 16% |
| Education | | | | | | |
| HS grad | 28% | 24% | 35% | 24% | 37% | 29% |
| Some college | 54% | 43% | 45% | 51% | 46% | 51% |
| College grad | 9% | 22% | 11% | 11% | 9% | 10% |
| Post college | 9% | 11% | 9% | 13% | 9% | 10% |
| HH Income | | | | | | |
| < \$20,000 | 31% | 28% | 35% | 23% | 32% | 31% |
| \$20-30,000 | 39% | 33% | 44% | 38% | 42% | 40% |
| \$30,000 + | 30% | 39% | 21% | 40% | 26% | 29% |
| Rank | | | | | | |
| Enlisted | 87% | 77% | 85% | 86% | 89% | 86% |
| Warrant Officer | 5% | 9% | 8% | 2% | 7% | 6% |
| Officer | 7% | 14% | 8% | 11% | 4% | 8% |
| Branch of Service | | | | | | |
| Army | 91% | 97% | 92% | 93% | 90% | 91% |
| Air Force | 9% | 3% | 7% | 7% | 10% | 8% |
| Other | 1% | 0 | 1% | 0 | 0 | 1% |
| ^a p<.05. | | | | | | |

Measures

Most data were obtained through items developed by the investigators associated with the original FBEP study. Family health measures were derived from standardized instruments for which reliability and validity have been well established. All data are available for four waves, which were roughly six months apart. Thus, analyses can assess the physical, emotional, social, and familial health of GWVs (and of the comparison groups), and changes in these health domains, over a minimum of 18 months. An additional three waves, one year apart, were also conducted, although changes in the original study resulted in some instruments or items being excluded. Consequently, seven assessments of health -- six months apart for Waves 1-4, and one year apart for Waves 5-7 -- are available for family measures only. Items at the first administration were asked in such a way as to assess whether the military person "ever" had the problem in question. At follow-up, items asked whether the problem had occurred since the previous interview.

Physical Health

Six items assess physical health. One item rates overall physical health on a 5-point ordinal scale (excellent to very poor). This item was also dichotomized to identify those who reported fair, poor, or very poor health versus good or excellent health. The former group was considered to have a problem in overall physical health. Five (dichotomous) items ask whether the person had been diagnosed with specific health conditions, including any serious disability, cardiovascular disease, HIV/AIDS, cancer, or other chronic illness. A summary measure counted the total number of physical health problems reported, which could range from zero to six.

Mental Health

Prior studies have found that depression and alcohol abuse are among the most frequent psychological problems reported by GWVs.¹ Substance use can also represent poor readjustment after the war. In the proposed study, seven items measure mental health status. Four ask whether the person had experienced depression, schizophrenia/psychosis, alcohol-related problems, or drug-related problems. Three other items ask whether, for any of these problems, the person had used inpatient services (e.g., hospital or residential treatment center), outpatient services (e.g., counseling), or prescribed medications.

Social Health

Four measures assess social health, specifically, the extent to which antisocial behavior among military personnel has exposed them to law enforcement. These dichotomous (yes/no) measures indicate whether they had been arrested or picked up by police; convicted of any crime; placed on probation; or imprisoned or jailed.

Family Health

Six standardized instruments, generating eight measures, were used to assess family health and well-being.

The Family Assessment Device (FAD)^{47,48} is based on the McMaster Model of Family Functioning that views families as interactional systems.⁴⁷ The 60-item instrument generates a

global General Functioning Scale, with higher scores indicating poorer functioning. Items ask about problem solving, behavior control, affective involvement, affective responsiveness, communication, and roles.

*The Family Index of Regenerativity and Adaptation (FIRA)*⁴⁹ is based on the T-Double ABCX model of family adjustment,⁵⁰ portions of which were adapted for military families.⁵¹ The FIRA produces three subscales that assess perceptions of community support, friend and relative support, and the family's outlook toward the military and military life. Items about community support assess the extent to which the family perceives the community as a source of potential support and feels a part of the community. Items about friend-relative support assess the degree to which the family can rely on family and friends as a coping strategy in times of stress. Items on views toward military life assess the family's ability to predict future work demands, control of the family's future by the military, the likelihood that the military will support the family in times of need, and their commitment to military life. Higher scores indicate greater regenerativity and adaptation, or support.

*The Family Inventory of Life Events (FILE)*⁵² is based on the Double ABCX model⁵⁰ and measures normative and non-normative, chronic and episodic, life events and changes in the family (e.g., a family member lost or quit a job, a family member was married). Higher scores indicate a greater number of changes, which can challenge families.

*The Family Resource Scale (FRS)*⁵³ is a 30-item instrument that measures perceptions of the adequacy of material resources such as time, money, and energy. Items assess the resources available to meet basic needs (health, shelter, nutrition), financial resources (income, employment), childcare, and higher order needs (growth and support, intra-familial support). Higher scores indicate more available resources.

*The Abbreviated Dyadic Adjustment Scale (ADAS)*⁵⁴ is a 7-item instrument that measures marital adjustment and overall happiness. Items assess a shared philosophy of life, common goals, exchange of ideas, working together, and overall happiness between the couple. Higher scores indicate greater marital satisfaction.

*The Brief Symptom Inventory*⁵⁵ is a 53-item self-report checklist designed to measure psychological symptoms. Sample items include feeling lonely, feeling fearful, trouble falling asleep, and difficulty making decisions. The BSI represents the psychological distress of the military person's spouse. Higher scores indicate greater psychopathology.

Summary Measures

Additional outcome measures based on the original items noted above were created to summarize health status. For the three domains of physical, emotional, and social health, a measure that counted the total number of problems within each domain was created. Another was created that counted the total number of problems across the three domains; this measure indicates the level of *problem severity*. Too, a variable was created that counted the number of domains (zero to three) in which any problem was reported; this measure represents the complexity or breadth of problems experienced. Unlike the measures of physical, mental, and social health status, the original measures of family well being were based on standardized instruments with well-established psychometric properties. They were continuous measures, ranging from zero to over 100, depending on the specific measure. Thus, the multiple measures of family well being are presented in their original unit of measurement.

Background Data

Items that assess the demographic and military profile of the sample include age, ethnicity, educational attainment, rank, branch of service, number of days away from home (regardless of deployment status), duration of deployment, and location of deployment. In general, variables such as these can either confound the effects of deployment on health and, if so, must be statistically controlled in analyses, or they can moderate the effects of deployment on health, such that certain groups of GWVs (e.g., based on their ethnicity or family's level of functioning) experience different outcomes than others. Analyses considered both possibilities.

Deployment Status

Measures of deployment status are of two types for this report. First, information was obtained from families at baseline (i.e., the 1st administration of the longitudinal study) on whether the military person was deployed at that time, had returned from deployment, or was not deployed or returned. For those deployed or returned, location of deployment was used to identify five groups: 1) those not deployed; 2) those currently deployed to some location other than the Gulf; 3) those currently deployed to the Gulf; 4) those who had returned from some place other than the Gulf; and 5) those who had returned from the Gulf. Results related to deployment status at baseline are based on this five-group approach.

The longitudinal analysis required a somewhat different approach. Note that we obtained information on deployment (dates, location) at each wave of the first four waves of the study, a timeframe that fully captured any deployments related to Desert Storm. Preliminary analysis showed that some families reported more than one deployment within each study wave. Moreover, some families reported a deployment at Wave 1 and not another until Wave 4 of the study. These "wave-based" deployment data had to be restructured to reflect sequential and date-dependent deployment "episodes" that were then tied to the appropriate wave-based reports of health. The episodes identify, at any given point in time, those who were stateside (not deployed), deployed to the Gulf, or deployed to some other region of the world.

Results from Baseline Analysis

Results associated with the physical, mental, social, and familial health status of military groups at baseline are first presented. Then the longitudinal results associated with change in health status are shown.

Initial Health Status by Deployment Status

Table 4 shows the health status of the military person across the physical, mental, and social domains. (Results related to family well being are shown later.)

Table 4. Personal Health By Deployment Status at Baseline

| | Not Deployed | Other Deployed | Gulf Deployed | Other Returned | Gulf Returned | Total |
|--|--------------|----------------|-------------------------|----------------|---------------|-------------|
| PHYSICAL | | | | | | |
| Any Physical Problems (6 items) | 13% | 8% | 15% | 9% | 5% | 12% |
| Overall Health Problem | 9% | 5% | 6% | 2% | 5% | 8% |
| Specific Conditions: | | | | | | |
| Serious disability | 2% | 0 | 2% | 0 | 0 | 2% |
| Cardiovascular disease | 2% | 0 | 0 | 0 | 0 | 1% |
| HIV/AIDS | <1% | 0 | 0 | 0 | 0 | <1% |
| Cancer | 1% | 0 | 0 | 2% | 0 | 1% |
| Other chronic condition | 5% | 3% | 8% | 5% | 0 | 5% |
| MH/A&D | | | | | | |
| Any MH/A&D Problem/Service Use (7 items) | 22% | 16% | 27% | 18% | 17% | 22% |
| Psychosis/Schizophrenia | 1% | 0 | 0 | 0 | 0 | 1% |
| Severe Depression | 8% | 0 | 6% | 2% | 2% | 6% |
| Alcohol | 10% | 8% | 21% | 7% | 9% | 11% |
| Drugs | 4% | 0 | 3% | 2% | 2% | 3% |
| Service Use: | | | | | | |
| Inpatient/RTC | 5% | 3% | 4% | 2% | 3% | 4% |
| Outpatient | 12% | 14% | 16% | 14% | 14% | 13% |
| Medication | 4% | 0 | 6% | 5% | 5% | 4% |
| SOCIAL | | | | | | |
| Any Criminal Involvement (4 items) | 17% | 8% | 16% | 20% | 19% | 17% |
| Arrested | 15% | 8% | 14% | 21% | 19% | 15% |
| Convicted | 10% | 3% | 8% | 10% | 5% | 8% |
| Probation | 7% | 3% | 9% | 10% | 2% | 7% |
| Jailed/Imprisoned | 6% | 0 | 8% | 7% | 9% | 6% |
| GLOBAL PERSONAL HEALTH | | | | | | |
| % With Any Personal Health Problem | 38% | 32% | 40% | 38% | 37% | 38% |
| <i>Among Those w/ Any Problem:</i> | | | | | | |
| Total # of Problems: Mean (SD) | 2.55 (1.81) | 1.42 (.79) | 2.67 (1.96) | 2.24 (1.25) | 1.95 (1.43) | 2.42 (1.73) |
| # of Domains w/ Any Problem: Mean (SD) | 1.37 (.56) | 1.00 (.00) | 1.42 (.61) ^a | 1.24 (.44) | 1.09 (.29) | 1.32 (.53) |
| ^a p<.05. | | | | | | |

Physical Health

Overall, 12% of the sample reports that their health is very poor, poor, or fair, or that they have been diagnosed with a specific health problem such as a serious disability or other chronic condition. Reports of specific health conditions such as cancer or cardiovascular disease are rare. None of the differences in these initial reports by deployment status is statistically significant.

Mental Health

Over a fifth (22%) of the sample reports some type of emotional problem such as depression, or problems related to alcohol or drugs (A&D), or the use of some services for emotional or A&D problems. Reports of alcohol problems (11%) are higher than for the other

problems in this domain, and while the rate (21%) of alcohol problems specifically among GWVs at baseline is elevated compared to others, the difference misses the generally accepted $p=.05$ level of significance ($p=.06$). The use (13%) of outpatient services for some type of emotional or A&D problem is comparable to the rate of those who report having alcohol (11%) and drug-related problems (3%). Use of outpatient services (13%) is more frequent than of more intensive forms (4%) such as hospitalization or treatment in a residential treatment center (RTC), or use of medications prescribed for emotional or A&D problems. Reports of mental health problems (including reports of service use) do not significantly differ by deployment status.

Social Well Being

Problems in social well being were operationalized by various measures of involvement in the criminal justice system (CJS), including whether the military person had been arrested, convicted, placed on probation, or jailed. Overall, 17% of the sample report having had some involvement with the system, with most (15%) of that involvement related to arrests. Reports of problems with social adjustment or well being do not vary significantly by deployment status.

Overall Personal Health

Table 4 also shows summary measures of the personal health of the various military groups. Overall, 38% report some type of personal health problem in either their physical, emotional, or social well being; the rates do not vary significantly by deployment status. Because most people did not report any physical, emotional, or social problems, any measure of the average number of problems would be heavily weighted downward by zeroes. So, two other summary measures are based only on those persons who reported at least one problem in any one of the three personal health domains. The total number of personal health problems for this group offers a measure of the severity of problems, and could range from one to 17. The results suggest that the total number of problems among those who report any problem is about two ($mean=2.42$), an average that does not vary significantly by group. We also looked at the complexity of problems, that is, the extent to which problems might be clustered in one domain, for example, physical health, or whether they were more widespread and manifest in multiple domains. The number of domains in which personal problems could be experienced ranged from one to three (physical, emotional, social). On average, military persons experienced problems in one area only ($mean=1.32$). However, results suggest that the problems of GWVs manifested in more areas of life than for others ($mean=1.42$; $p=.02$).

Summary of Personal Health Problems at Baseline

In sum, GWVs, either those deployed to the Gulf or those who had returned from the Gulf prior to the first wave of data collection, tend to report similar types and levels of problems than others. One exception was problem complexity, where GWVs reported problems in more areas of life, or domains, than the others. There is some tendency for those who were deployed to the Gulf at baseline to be more likely than others to report mental health-related problems (27%), particularly with alcohol (21%); however, this finding misses the standard criterion for statistical significance. Moreover, the finding reflects this aspect of their emotional health status before returning home from the Gulf. Those who had returned from the Gulf by baseline report similar rates of emotional problems and of alcohol use specifically (9%) as those who had returned from other locations (7%) or those who had not deployed (or returned) at all (10%). In sum, the baseline health status among GWVs does not seem to differ from that of other military groups.

Table 5. Family Well Being By Deployment Status at Baseline

| | Not Deployed | Other Deployed | Gulf Deployed | Other Returned | Gulf Returned | Total |
|------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| | <i>Mean (SD)</i> | <i>Mean (SD)</i> | <i>Mean (SD)</i> | <i>Mean (SD)</i> | <i>Mean (SD)</i> | <i>Mean (SD)</i> |
| Marital Satisfaction | 3.25 (.87) | 2.75 (1.10) | 3.09 (1.09) | 3.19 (.81) | 3.11 (1.09) | 3.18 (.95) |
| Spousal Distress | 55.11 (11.04) | 58.61 (9.30) | 59.41 (9.74) | 58.44 (9.18) | 55.20 (11.16) | 56.32 (10.71) |
| Material Resources | 123.02 (17.9) | 121.82 (18.69) | 120.39 (19.71) | 120.25 (16.73) | 124.75 (18.13) | 122.50 (18.19) |
| Family Life Events | 10.67 (5.67) | 11.21 (5.33) | 12.41 (5.60) | 12.42 (5.96) | 10.74 (5.58) | 11.11 (5.67) |
| Friend-Relative Support | 24.09 (5.83) | 26.63 (4.38) | 24.93 (5.67) | 24.50 (5.27) | 23.95 (5.87) | 24.39 (5.70) |
| Community Support | 58.97 (7.61) | 59.29 (6.77) | 59.78 (8.17) | 57.50 (8.47) | 57.01 (9.54) | 58.78 (7.95) |
| Family Dysfunction | 2.05 (.48) | 2.17 (.39) | 2.10 (.46) | 2.10 (.43) | 2.15 (.52) | 2.08 (.47) |
| Perceptions of Military Life | 53.46 (9.82) | 48.38 (9.73) | 51.43 (9.60) | 51.54 (9.21) | 51.56 (11.16) | 52.50 (9.95) |

Family Health at Baseline

Table 5 shows the mean and standard deviation for the various measures of family health and well being for each of the military groups by their baseline deployment status as well as for the total sample. Results suggest that the nature of family well being among GWVs (either deployed or returned) at baseline tends to be much the same as among other military groups. While there is some tendency for those not deployed at all to have greater marital satisfaction (*mean*=3.25), spouses with lower levels of psychological distress (*mean*=55.11), and less negative perceptions of military life (*mean*=53.46) compared to those deployed or returned from deployments (Gulf or other locations), these differences are not beyond what would be expected by chance alone. Similarly, there is some tendency among those who deployed at baseline either to the Gulf or elsewhere for marital satisfaction to be lower (*mean*=3.09; *mean*=2.75, respectively) and psychological distress among their spouses (*mean*=59.41; *mean*=58.61, respectively) to be higher compared to those who have returned from some deployment or those not deployed at all. The perceived support from the community, friends and relatives tends to be greater among those deployed either to the Gulf (*mean*=59.78) or elsewhere (*mean*=59.29) compared to others. But these differences in baseline status fail to meet (Chi-square) statistical tests of significance. In short, family well being does not seem to depend on the deployment status of military personnel as reported during the initial wave of data collection.

Deployment status appears to be unrelated to initial reports of family well being. However, Table 6 shows that the various family measures significantly covary in expected and potentially important ways. There is a significant correlation between psychological distress among spouses of all active military and family functioning, life events, community resources, and material resources. Spouses with more psychopathology tend to report greater family dysfunction ($r = .34$), more life events to challenge them ($r = .43$), less support from the community ($r = -.34$) and fewer material resources ($r = -.44$). More life events (including but not limited to those related to military duty) also correlate with heightened family dysfunction ($r = .35$), less marital satisfaction ($r = -.18$), fewer material resources ($r = -.39$), and less community support ($r = -.24$).

Table 6. Correlations Among Family Measures

| | Spousal Distress | Family Dysfunction | Life Events | Material Resources | Friend-Relative Support | Community Support | Perceptions of Military Life |
|-------------------------|------------------|--------------------|-------------|--------------------|-------------------------|-------------------|------------------------------|
| Marital Satisfaction | -.284(**) | -.530(**) | -.176(**) | .293(**) | .063 | .362(**) | .271(**) |
| Spousal Distress | | .342(**) | .426(**) | -.442(**) | -.020 | -.338(**) | -.310(**) |
| Family Dysfunction | | | .345(**) | -.262(**) | -.050 | -.460(**) | -.258(**) |
| Life Events | | | | -.387(**) | .160(**) | -.238(**) | -.227(**) |
| Material Resources | | | | | -.019 | .379(**) | .428 (**) |
| Friend-Relative Support | | | | | | .187(**) | -.036 |
| Community Support | | | | | | | .414 (**) |

** Correlation is significant at the 0.01 level (2-tailed).

Perceptions of military life include views about the degree to which the needs of the military seem to supercede their own, that the family has some control over the military's plans for them, that the military supports them with their problems or concerns, that they are free to speak out on issues without reprisal, that they are committed to the overall mission of the military and that they are inclined to stay in the military. As Table 6 shows, perceptions of the military establishment and life in the military are significantly more negative among spouses with less-satisfying marriages ($r=.27$), higher levels of psychopathology ($r=-.31$), poorer functioning families ($r=-.26$), more life events to face ($r=-.23$), fewer material resources such as money and time available to meet their needs ($r=.43$), and less support from their community ($r=.41$).

Longitudinal Analysis

Special Problems

The longitudinal analysis had to solve a number of problems that often arise in secondary analysis of data that are not gathered with a present study in mind. In the case of this study, a technically thorny problem was the variability in the number and timelines of deployment. Figure 1 shows that most families had one deployment, though the number ranged from zero to five.

Figure 2 shows selected patterns of deployment of the sample as timelines or deployment trajectories of individual soldiers. In the figure, the X axis shows time during the first 18 months of the FBEP (a timeframe that includes Desert Storm deployments). The Y axis is an indicator (0-1) of whether the soldier was deployed (Deployed = 1) or not (Deployment = 0). The examples in Figure 1 are quite variable, ranging from no deployment (top left), to one deployment at various times and lengths (rows 2-3), and to two or even three deployments (rows 4-5) in a few cases.

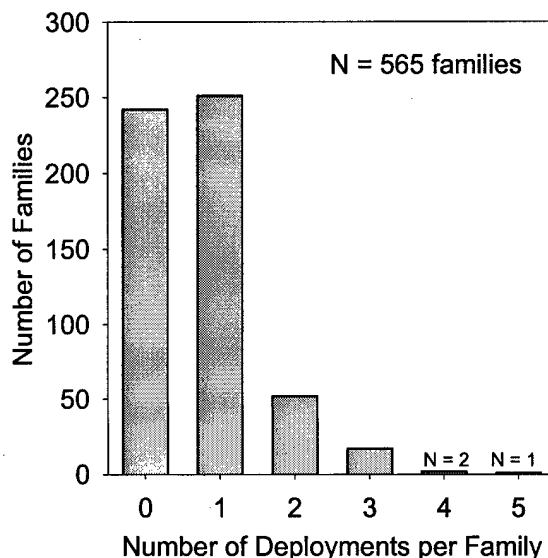
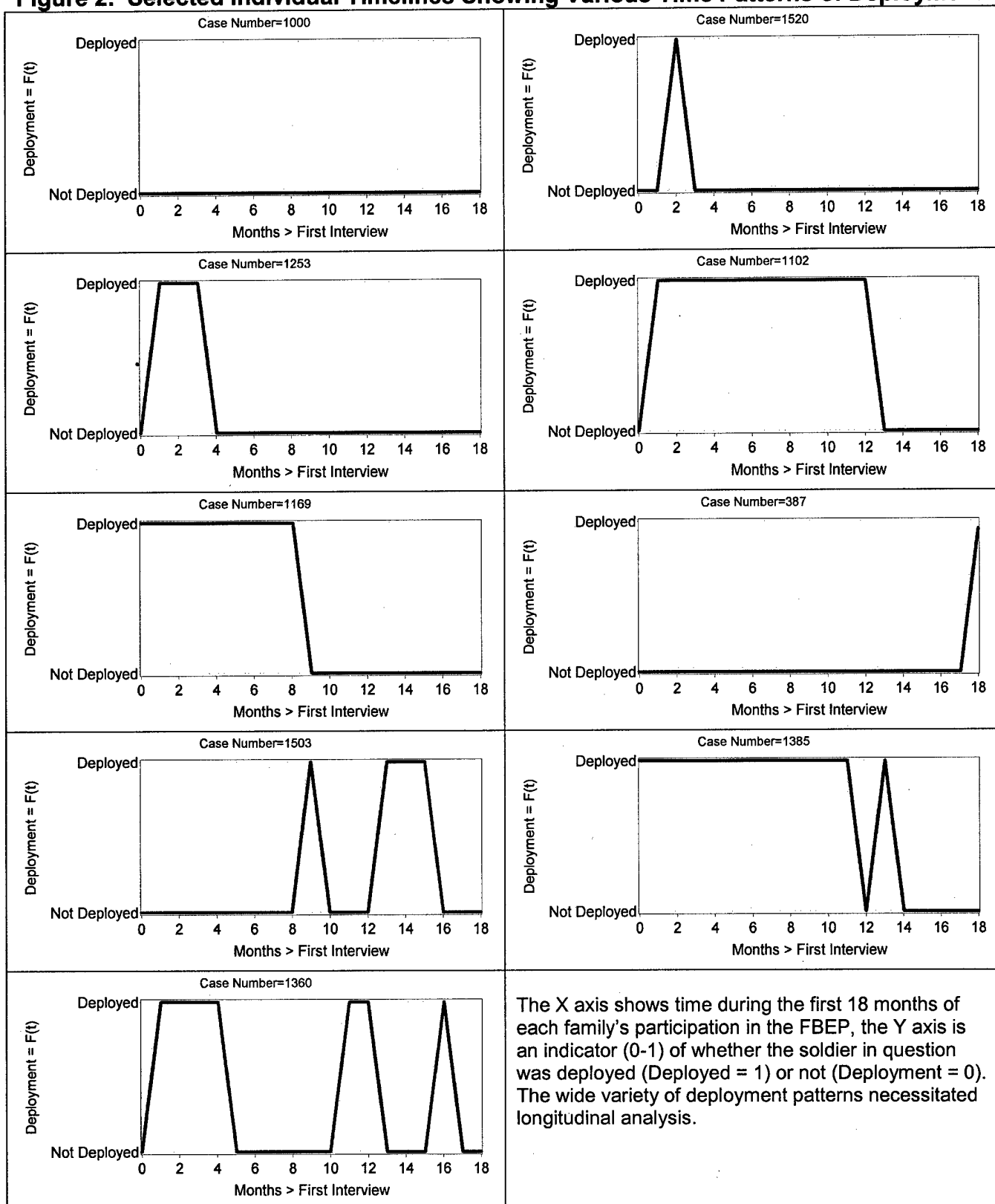
Figure 1. Most of the 565 Families Had One Deployment

Figure 2. Selected Individual Timelines Showing Various Time Patterns of Deployment

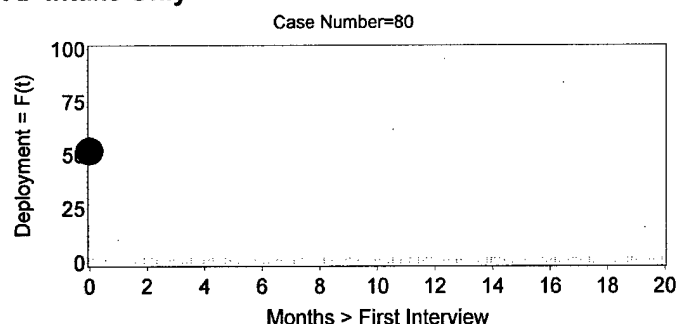


These deployments occur at seemingly random times in a wide variety of patterns because deployments were based on military necessity rather than the timeline of the original study (FBEP).

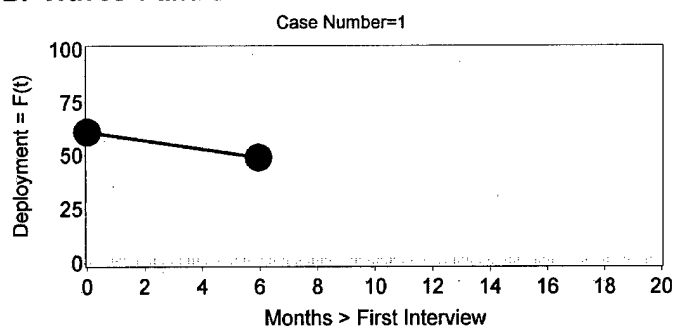
As various patterns of deployment were observed, so too were patterns of outcome ratings. Ideally, each case would contribute four repeated measurements of each outcome, but realistically there were many patterns of completeness. Figure 3 shows for one of the outcome measures (BSI: spousal distress) that some cases have only one observation (A), some have two or three (B-D), and others have all four (E). Too, while the FBEP attempted to conduct interviews in equal six-month intervals, intervals varied; for example, while the average interval between the 1st and 2nd interview was 189 days (roughly six months), individual intervals ranged from 124 to 311 days. In reality each case had a unique pattern of interview dates. Later, we show the completeness of each major outcome measure, but note here that the longitudinal statistical model uses all data available for each case regardless of its pattern of completeness.

Figure 3. Five Examples of Completeness

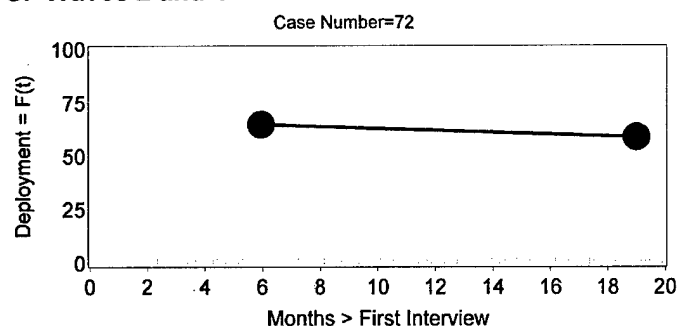
A. Intake Only



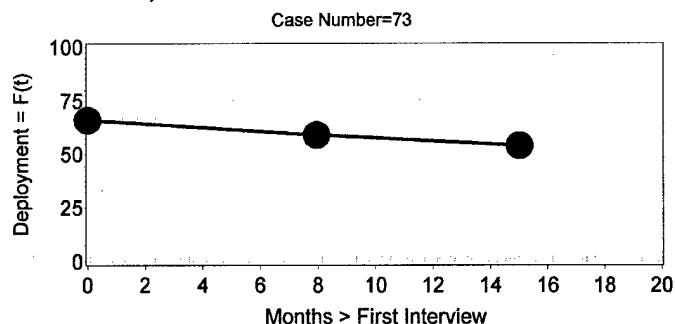
B. Waves 1 and 2



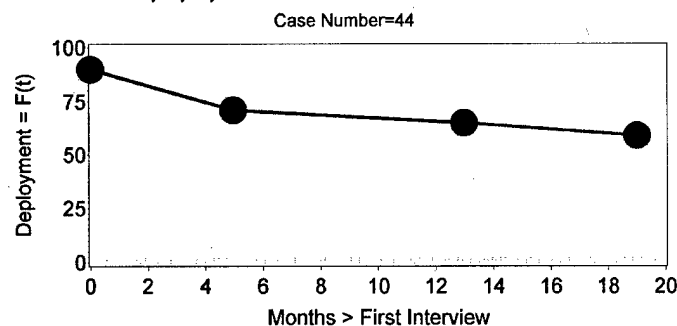
C. Waves 2 and 4



D. Waves 1, 2 and 3



E. Waves 1, 2, 3, and 4



While the FBEP aimed for 6-month data collect intervals, each family had a unique pattern of time intervals. Missing values were common, with the average family missing about one of four possible data collection waves. These unique patterns of measurement, along with unique time patterns of deployment, were reconciled with a computer program that produced a longitudinal record appropriate for analysis.

Together, Figures 2 and 3 suggest that deployments and outcome measures were marching to different drummers. To reconcile these unique time-varying records for each individual, a computer program was designed that looped through every day from December 5, 1987 to December 8, 1994 (2560 days), comparing each date to the dates of first, second, third, and fourth deployments.

For the $N = 565$ families, this produced about $565 * 2560 \approx 1.45$ million observations. For efficiency, dates of deployment and of outcome measurements were rounded to the fifteenth of each month, reducing the number of observations to about 47,000. Indicator variables (0-1, true-false) were devised to represent deployment on each of the 2560 days in the study's range such that for each day, the subject was either deployed (1) or not (0). These deployment timelines were then linked with the outcome data to produce a data file in which each outcome had a date with its associated deployment indicators. Each family had up to four outcomes with dates, times since entry to the study, and deployment indicators. In the longitudinal analysis only observations with outcome scores are considered, so that the maximum number of observations would be $565 * 4 = 2260$.

Table 7 shows an example of these time-varying observations, which are explained in detail in the table footer. The Table shows that Family #228 provided reports on family functioning (FAD) on three of the possible four occasions. At the time of the first observation (Months = 0), the soldier was deployed, having been sent overseas before data collection began.

Table 7. Example of Longitudinal Data Structure for Case #228

| VUID | Date | Months | Ever Deployed | Deploy1 | Deploy2 | Deploy3 | Deploy4 | Family Dysfunction (FAD) | DepOrder1 |
|------|-----------|--------|---------------|---------|---------|---------|---------|--------------------------|--------------|
| 228 | 15-Feb-91 | 0 | 1 | 1 | 0 | 0 | 0 | 2.22 | 1, During D1 |
| 228 | 15-Sep-91 | 7 | 1 | 0 | 0 | 0 | 0 | 2.36 | 2, After D1 |
| 228 | 15-Nov-92 | 21 | 1 | 0 | 0 | 0 | 0 | 2.25 | 2, After D1 |

This case had one deployment (ever deployed = 1). The variable "Deploy1" represents the first deployment. In February 1991, the soldier deployed (Deploy1 = 1), then returned home after that, so that Deploy1 = 0 for the two subsequent dates. There were no other deployments in the study period (Deploy2 to Deploy4 = 0). Family #228 had FAD Family Functioning scores on 3 dates in 1991 and 1992, at 0, 7, and 27 months after entering the FBEP. The first FAD report was made during the first deployment, and the others were made after the first deployment. In this way each FAD report had deployment status as a time-varying covariate. With $N = 565$ families with a possible 4 waves of outcome measurements, the maximum number of records possible is $565 * 4 = 2260$.

The Basic Structure of the Statistical Model

The occasion-based records described above could be analyzed in longitudinal models of the general form:

$$\text{Outcome} = F(\text{Time}, \text{Deployment})$$

This basic model could be extended by adding mediators or moderators in an extended model.

$$\text{Outcome} = F(\text{Time}, \text{Deployment}, \text{Moderators})$$

Mediating effects are defined as those that can confound the relationship between deployment and health outcome to the extent that they are related as well (e.g., age, ethnicity). Moderating effects, say of ethnicity, suggest that any relationship between deployment and outcome depend on which group is considered – Black or White personnel. Note that Table 3 above showed no differences in those variables (mediators) that might potentially confound the analysis. Thus, we explore only potentially moderating effects in follow-up analyses below.

The longitudinal model developed uses all information from each case, deployed or not, and it can even sort out the effects for unusual cases, such as someone deployed to the Gulf at one time and deployed elsewhere another. The longitudinal software, SAS PROC MIXED,⁵⁶ iteratively searched for parameters that led to the best fit both for individual timelines (Level 1, within family) and for the effects of deployment (Level 2, between families).

With the general model described, we now show in general terms how results can be interpreted from the model. We use one of the family outcomes – spousal distress (BSI) – to illustrate. Spousal distress is a continuous measure where higher scores indicate greater psychopathology (high="bad"). Because the unit of measurement of this (and other) variables means little to most readers, we standardized the measure to have a mean of zero (SD = 1). This standardization offers the advantage of plotting all results on a common metric. In addition, these standard z-scores relate directly to effect size estimates, the most popular of which is Cohen's⁵⁷ $d = (X_1 - X_2) / SD_{pooled}$. Cohen's well-known formula defines effect size as the difference between two groups measured in standard deviations. His widely accepted standards for effect size, namely small, medium, and large effects are defined as 0.2, 0.5, and 0.8 SDs, respectively.

The effects of deployment on a given outcome such as spousal distress may be thought of as a timeline graph. In Figure 4 (A&B), the X axis is time in months from the beginning of data collection for the FBEP. The Y axis is the standardized BSI score. Timelines are shown for three groups, those deployed to the Gulf, those deployed somewhere else, and those not deployed at all.

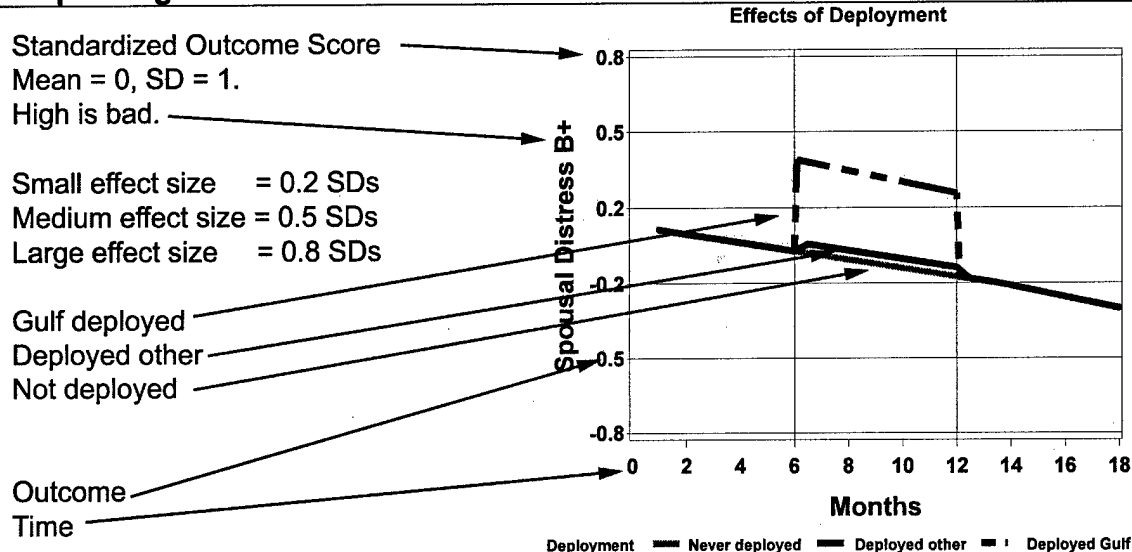
Parts A and B in Figure 4 show an overall effect of time, as indicated by the slight constant decline for all groups. This overall decline, or negative slope, is of little interest because it affects the three groups (Gulf, other deployed, not deployed) and the three time periods (before, during, and after deployment) equally. Figure 4B shows the specific effects of deployment. Here we see that GWVs experienced significantly more spousal distress in their families than those deployed elsewhere or those not deployed at all.

While the timeline charts are relatively easy to interpret, they do not distinguish reliable differences from the chance variation of sampling error. Generally large differences are statistically significant (defined as $p < .05$), but sometimes they may be nonsignificant if the standard errors of parameters in the model are large. Table 8 shows the parameter estimates and significance tests of the longitudinal model. Estimates of primary interest are italicized.

The effects of interest are the Beta (β) coefficients for the Not deployed (-0.421) and the Other Deployed (-0.373). These coefficients are statistically significant, as shown in the column headed "Significance." The Gulf Deployment parameter is equal to zero and has a dot instead of a significance level because it is the comparison condition. Since Spousal Distress is scored high=bad, the negative coefficients mean significantly less distress in the not deployed and other deployed conditions. These are small to medium size differences.

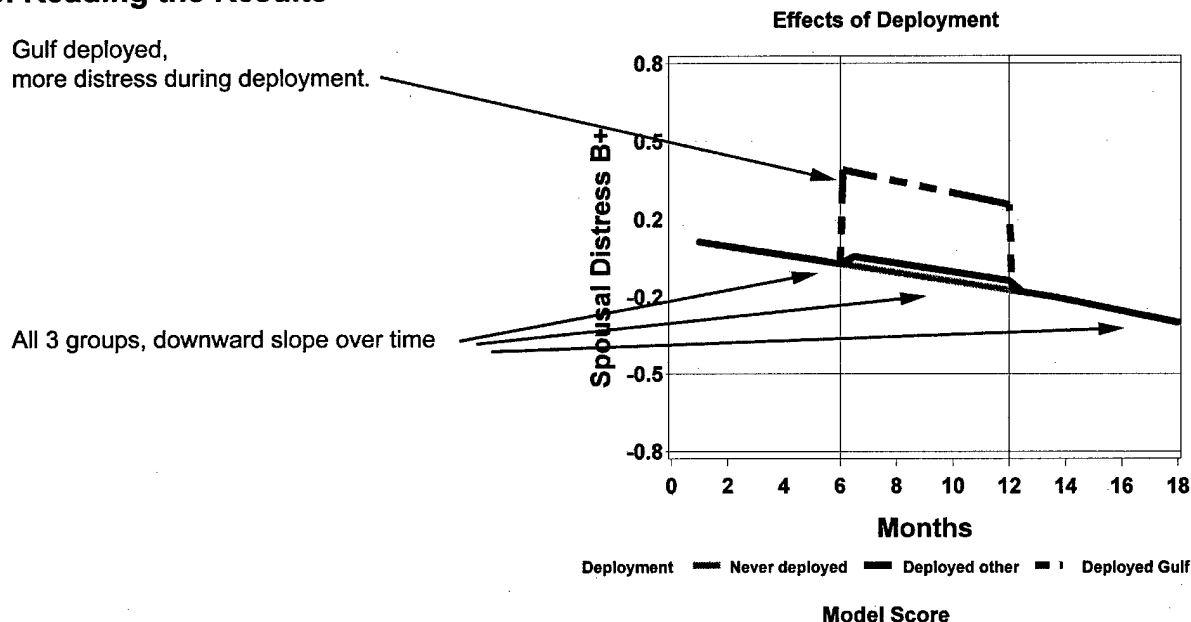
Figure 4. Terms of the Basic Longitudinal Model

A. Explaining the Outcome Plot



Understanding deployment is complicated by the effects of time and by the differing units of various measures. For clarity, we display model scores based on the parameters of the sample. These model scores illustrate 3 cases who were deployed between month 6-12. To control for time, the nondeployed group had a "deployment to nowhere" randomly assigned; this random assignment matched the mean, mode, and variance of those actually deployed.

B. Reading the Results



The longitudinal model has terms representing the overall effect of time and the effects of deployment (not deployed, deployed other, and Gulf deployed). If Gulf deployment produced spousal distress, we would expect to see more serious problem scores for Gulf deployment during or after the period of deployment. Here, we see more negative results during deployment, but none after.

Table 8. Basic Longitudinal Model: Between-Subject Effects of Deployment on Spousal Distress

| Effect | Deployment Type | β | Std Error of β | DF | Significance | Interpretation |
|----------------|-----------------|---------|----------------------|-----|--------------|--|
| TimeMonths | | -0.023 | 0.003 | 421 | <.001 | Decrease over time for all groups |
| DeployAnyWhere | 0, Not Depl | -0.421 | 0.106 | 445 | <.01 | Not Deployed, lower distress than GWVs |
| DeployAnyWhere | 2, Dpl Other | -0.373 | 0.146 | 445 | 0.01 | Other Deployed, lower distress than GWVs |
| DeployAnyWhere | 3, Depl Gulf | 0 | . | . | . | GWVs are the comparison group |

Time-Varying Health Outcomes

Now that we have illustrated the longitudinal model and how to identify results, we now turn to the other outcome measures. Table 9 shows descriptive information on the thirteen outcomes. Most of these outcomes are "high=bad," spouse distress, for example. They are marked "B+." For four outcomes, a high score is more positive (high="good."), material resources, for example. These are marked "B-." The most sensitive measures are the continuous approximately-normal outcomes 6-13. Continuous outcomes are analyzed by the longitudinal hierarchical linear model. Count outcomes (1-5) differ too radically from the normal distribution to be analyzed with the HLM; instead, they are analyzed with generalized estimating equations (GEE), a model that accounts for clustered observations nearly as flexibly as the HLM.

Table 9. Descriptives for Longitudinal Outcome Measures

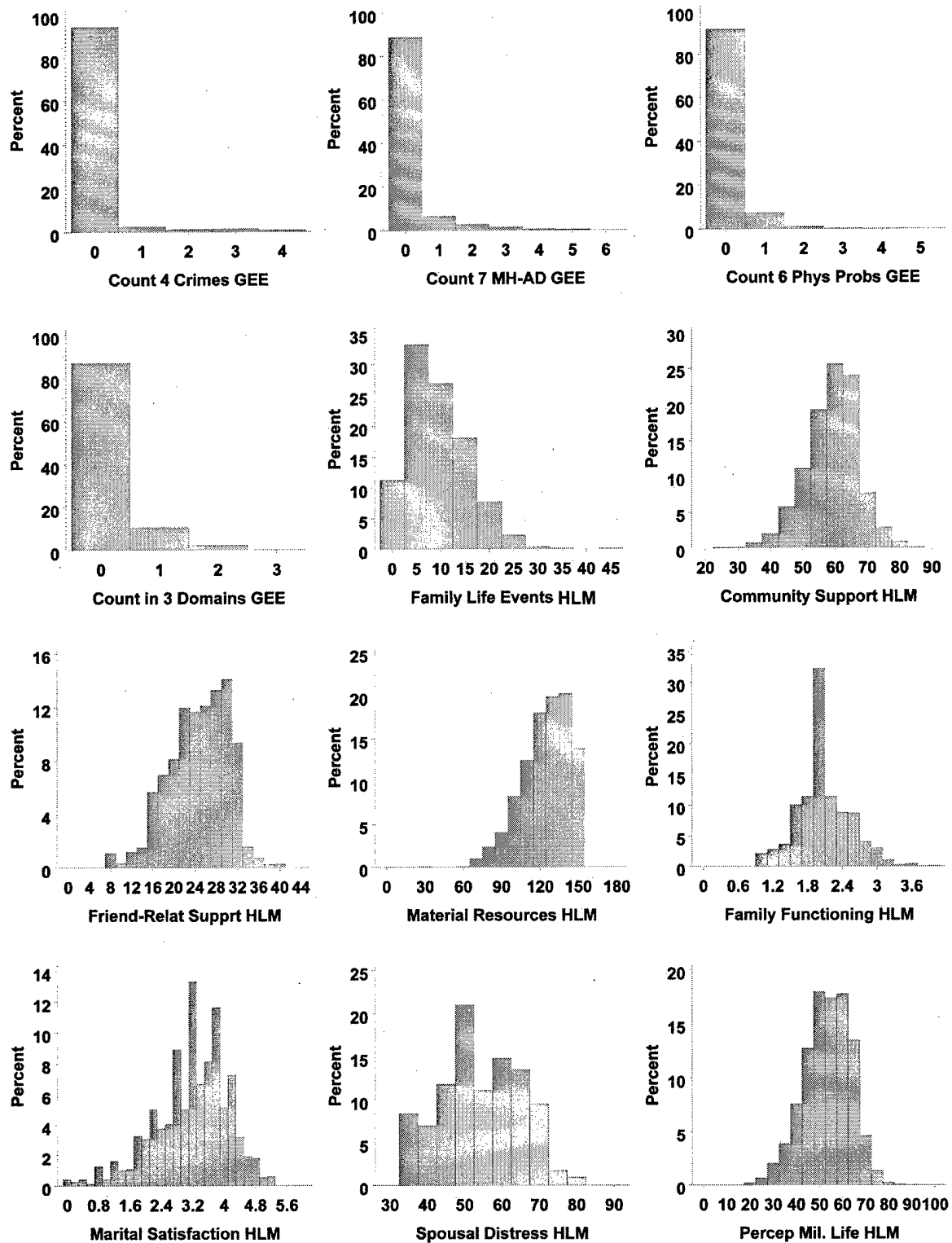
| Label | Observations | Completeness | Mean or Pct | Std Dev. | Min | Max | Longitudinal Model |
|-------------------------------------|--------------|--------------|-------------|----------|-----|-----|--------------------|
| 1. Count of 3 Domain Problem B+ | 1963 | 87% | 0.25 | 0.55 | 0 | 3 | Poisson or NB GEE |
| 2. Count On 4 Crime Questions B+ | 1963 | 87% | 0.11 | 0.54 | 0 | 4 | Poisson or NB GEE |
| 3. Count Of 6 Phys. Health Probs B+ | 1963 | 87% | 0.10 | 0.35 | 0 | 5 | Poisson or NB GEE |
| 4. Count Of 7 Mh-Ad Items B+ | 1963 | 87% | 0.19 | 0.64 | 0 | 6 | Poisson or NB GEE |
| 5. Sum of Problems B+ | 1652 | 87% | 0.40 | 1.05 | 0 | 12 | Poisson or NB GEE |
| 6. Marital Satisfaction B- | 1652 | 73% | 3.17 | 0.93 | 0 | 5.1 | Normal HLM |
| 7. Family Life Events B+ | 1762 | 78% | 9.37 | 6.04 | 0 | 45 | Normal HLM |
| 8. Family Func. Probs B+ | 1748 | 77% | 2.07 | 0.45 | 1 | 3.9 | Normal HLM |
| 9. Friend-Relative Support B- | 1742 | 77% | 24.36 | 5.57 | 8 | 40 | Normal HLM |
| 10. Perceptions Of Military Life B- | 1549 | 69% | 53.39 | 10.12 | 21 | 84 | Normal HLM |
| 11. Spousal Distress B+ | 1371 | 61% | 53.74 | 11.30 | 33 | 80 | Normal HLM |
| 12. Community Support B- | 1737 | 77% | 59.02 | 8.06 | 27 | 85 | Normal HLM |
| 13. Material Resources B- | 1654 | 73% | 123.95 | 18.55 | 34 | 150 | Normal HLM |

Notes:

B+ = High is bad, B- = High is good. GEE = Generalized estimating equations for outcomes that are not normally distributed. NB = negative binomial distribution, a form of Poisson regression with technical advantages. HLM = Hierarchical linear model for normally distributed outcomes.

The decision as to which model to use was based on inspection of the distribution of each variable, as shown in Figure 5. The first four outcomes in Figure 5 are highly skewed counts with a mode of zero. These violate the assumptions of the HLM because they are so far from the normal distribution. Generalized estimating equations (GEEs) offer a way to analyze these because they are not limited to normally distributed outcomes. The GEE model offers a choice of distributions (e.g., binary, Poisson, negative binomial) so GEEs can be used to analyze a wide variety of non-normal outcomes.

Figure 5. Distributions of Longitudinal Outcomes



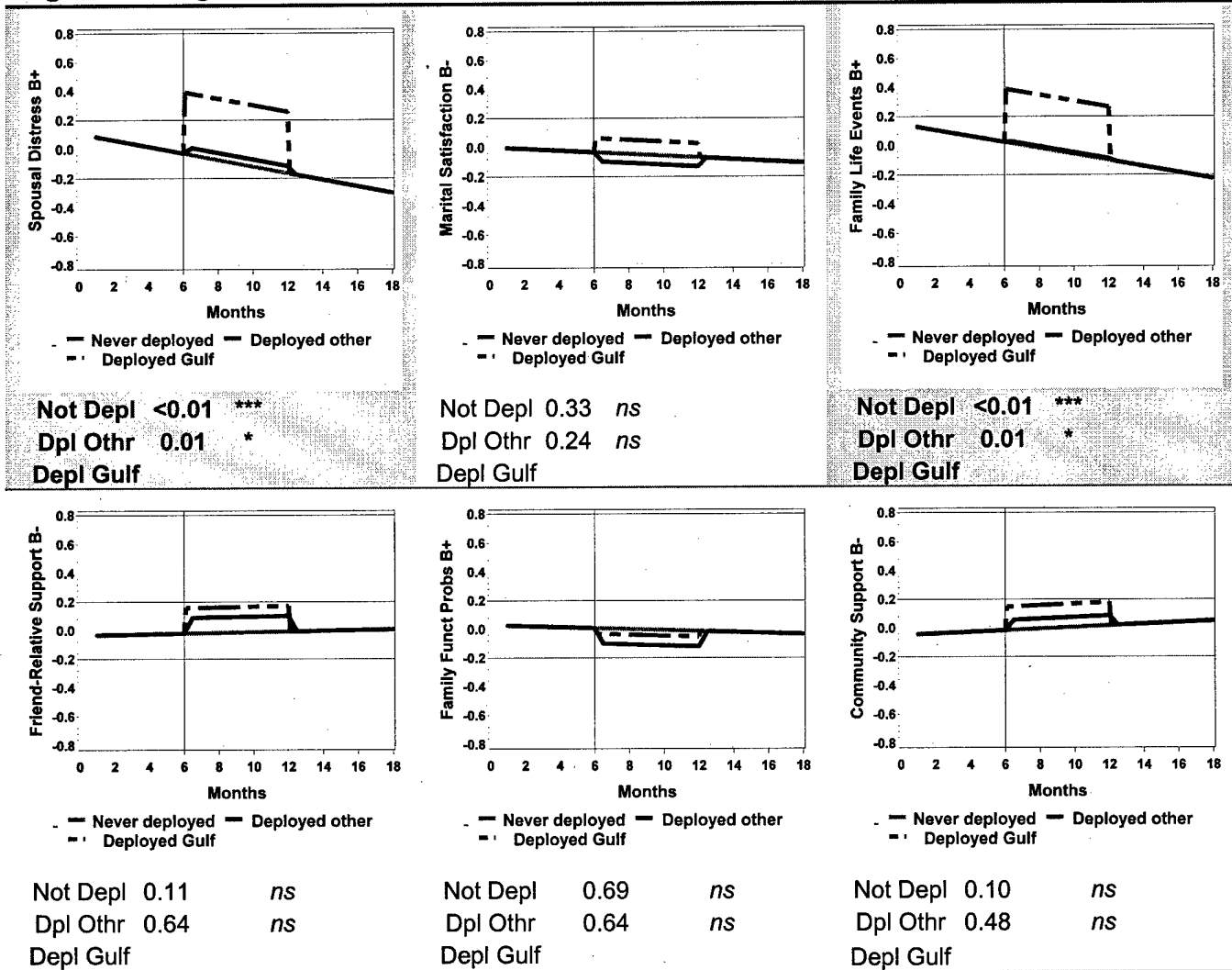
Outcome measures can be classified as counts or continuous. Counts are analyzed with longitudinal generalized estimating equations (GEE) using Poisson or negative binomial distributions. Continuous outcomes are analyzed with longitudinal hierarchical linear models (HLMs).

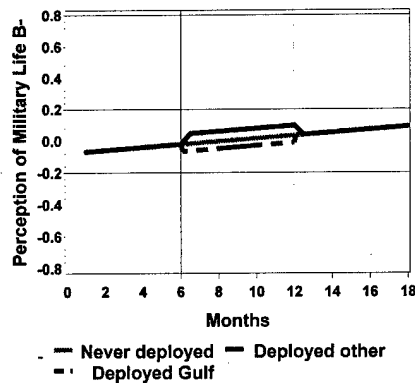
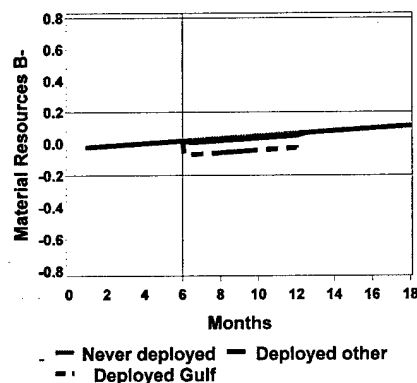
Longitudinal Results

Above, we reviewed the general statistical model and illustrated interpretation of results with one of the family health outcomes – Spousal Distress. Here, we present the HLM analyses (for the continuous variables) and the GEE analyses (for the count variables) of the effects of deployment. We begin with the simplest possible model. After presenting basic results, we conduct specific follow-up analyses to evaluate three special issues: 1) potential attrition bias; 2) a more detailed analysis of the role of time pre- & post-deployment; 3) whether three additional waves of data would make a difference in results; and 4) possible moderators of basic findings (such as age and race).

Figure 6 shows the HLM model scores for the eight continuous outcomes. Probabilities from significance tests appear beneath each figure; a probability of less than 0.05 is needed for significance. Probabilities are flagged as *** $p < .001$, ** $p < .01$, * $p < .05$ or *ns* (non significant).

Figure 6. Longitudinal Continuous Outcomes by Deployment





The figure shows outcomes on family scales (approximately normal continuous outcomes). Hierarchical linear model: Outcome = F(Time, Deployment), where Deployment is None, Other, or Gulf. There was significantly more Spousal Distress and more challenging Life Events for GWVs.

Under each chart, a table shows the statistical significance of two comparisons: Gulf vs Not deployed and Gulf vs Other deployed

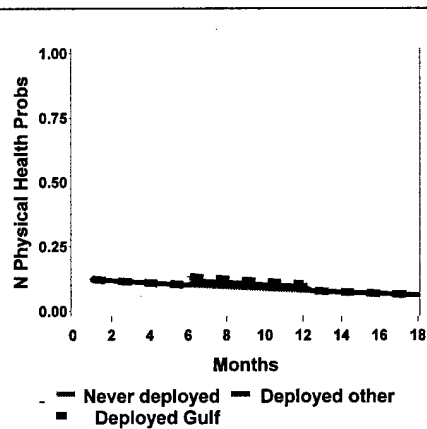
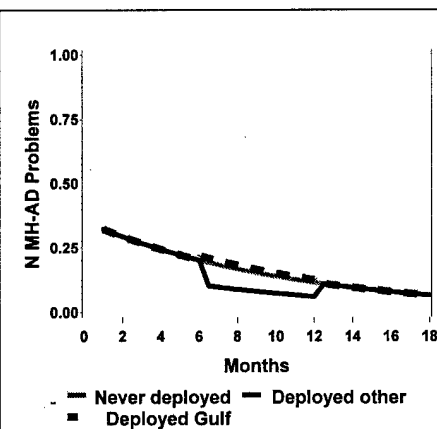
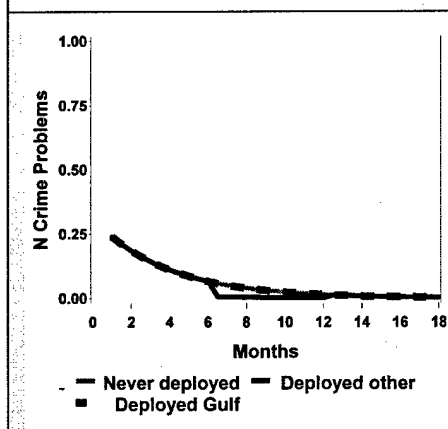
| | |
|-----------|----------------|
| Not Depl | 0.34 <i>ns</i> |
| Dpl Othr | 0.55 <i>ns</i> |
| Depl Gulf | |

| | |
|-----------|----------------|
| Not Depl | 0.63 <i>ns</i> |
| Dpl Othr | 0.39 <i>ns</i> |
| Depl Gulf | |

There are two significant effects of deployment, which are shaded in the charts of Figure 6—spousal distress and life events. For GWVs, the severity of their spouse's psychiatric distress and the number of life events that challenged their families were significantly greater than observed for the other military groups.

Figure 7 shows results from the analysis of the count outcomes, where the GEE model is applied to estimate the effects of deployment.

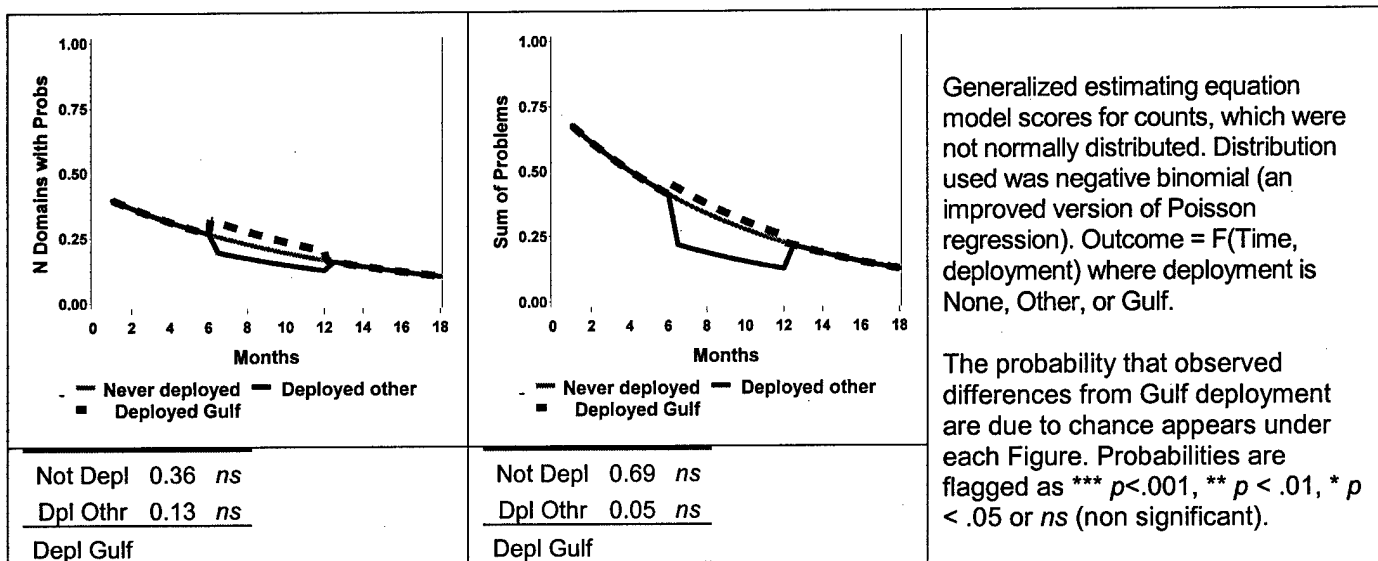
Figure 7. Longitudinal Model Scores for Count Outcomes



| | |
|-----------|----------------|
| Not Depl | 0.97 <i>ns</i> |
| Dpl Othr | 0.03 * |
| Depl Gulf | |

| | |
|-----------|----------------|
| Not Depl | 0.81 <i>ns</i> |
| Dpl Othr | 0.20 <i>ns</i> |
| Depl Gulf | |

| | |
|-----------|----------------|
| Not Depl | 0.45 <i>ns</i> |
| Dpl Othr | 0.83 <i>ns</i> |
| Depl Gulf | |



The GEE analyses, as the earlier HLMs, generally show an overall decrease with time, which was not an effect of Gulf deployment. (Note that the time slopes of the GEEs are curved only for a technical reason, namely, they are based on the log of outcomes.) There is only one statistically significant effect of deployment, as indicated by the shaded chart. There was a very slight decrease in social well being (crime reports) among those deployed to noncombat regions. Changes for GWVs and for those not deployed at all were statistically equivalent.

The GEE analyses (Figure 7) are based on ad hoc summary measures that included relatively small numbers of items, which preliminary analyses indicated were limited by floor effects (i.e., many reports of zero problems). On the other hand, the HLM analyses (Figure 6) were based on the more precise HLM for continuous data, and standardized measures that have a large number of items and well-established psychometric properties. Overall, we think the longitudinal results identify two robust consequences of Gulf deployment, both involving the health and well being of the military person's family rather than their own personal health status. Spouses of GWVs are significantly more likely than spouses of others to have elevated psychopathology and for their families to experience significantly more life events that can threaten their family well being.

Reportable Results for Family Measures

Continuous Outcomes

- More spousal distress during Gulf deployment than Other deployment or No deployment (medium effect sizes).
- More challenging life events during Gulf deployment than Other deployment or No deployment (medium effect sizes).

Count Outcomes

- Slightly lower social well being (crime-related problem count) during other-deployment than with Gulf deployment.
- Differences in mental health (including A&D) problems, physical problems, problem severity, and problem complexity are not statistically significant.

Follow-up Analyses

To expand the research and help assure the integrity of findings, we conducted additional analyses (based on the continuous, HLM outcomes only) to address four issues:

- Differences in attrition may bias results.
- The simple time model ignores before & after deployment effects.
- Seven waves of data may be better than four.
- Effects of Gulf deployment may differ for important groups (e.g., based on ethnicity).

Attrition Analysis

Since individuals vary in the completeness of their outcome data, it is conceivable that there is something relevant for deployment and health status that separates those with complete data from those with sparser records. To test this possibility and, if necessary, control for it, we added completeness as an additional variable in the HLM analyses. "Completeness" was defined as the number of complete scores available divided by the maximum possible, which was 8 measures x 4 waves = 32 possible scores per family. If there are significant effects involving completeness, then we could conclude that there is an attrition artifact. This analysis was guided by a well known model of Hedeker and Gibbons.⁵⁸

The average family's outcome records were 73% complete so that the average family completed about 3 of the 4 possible data collection opportunities. Figure 8 shows the distribution of overall completeness. The distribution has 4 modes at 100%, 75%, 50%, and 25% because of missed waves. It is worth noting that the HLM analyses use whatever data are available, never deleting cases because of missing values. This is an important advantage of HLM over traditional ordinary least squares models.⁵⁹ If data are missing completely at random,⁶⁰ then the only consequence of missing data is a reduction in statistical power, not a distortion of results.

Attrition was centered by a z-transformation making the average zero; positive and negative completeness scores represent those who are above average or below average. The earlier HLM model was re-run on all 8 family outcomes with two terms added: a) Completeness and b) Completeness by deployment.

Figure 8. Distribution of Completeness

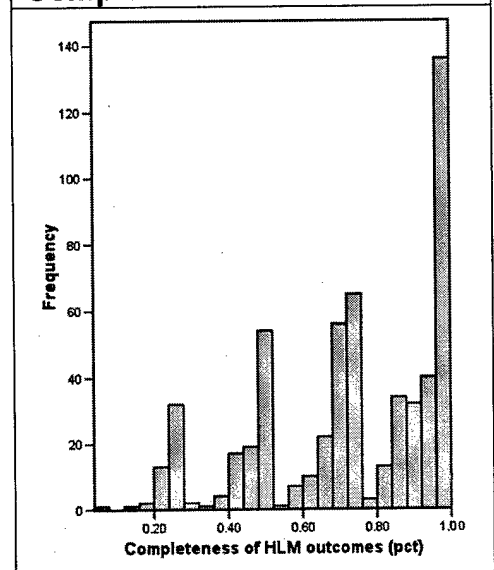


Table 10 shows the significance levels for the attrition analysis. Results suggest that there generally was no significant connection between the completeness of the data and outcome scores. In one case, Marital Satisfaction, there was a statistically significant ($p = 0.04$) influence of completeness on outcome. In this case, spouses in the "Deployed Other" condition were more satisfied with their marriages when they had more-than-average missing data. This one significant effect among 16 tests (8 for "other deployed" and 8 for "not deployed") may be due to chance alone, since it is not significant under Bonferroni's multiple test criterion of $0.05 / 16 = 0.003$. In conclusion, the attrition analysis suggests that the family outcomes reported earlier were not distorted by missing data.

Table 10. Longitudinal Attrition Analysis

| | Outcome | Completeness | Completeness by Deployment |
|----|------------------------------|--------------|----------------------------|
| 1. | Spousal Distress | 0.21 ns | 0.50 ns |
| 2. | Marital Satisfaction | 0.99 ns | 0.04 * |
| 3. | Life Events | 0.79 ns | 0.08 ns |
| 4. | Family Dysfunction | 0.96 ns | 0.93 ns |
| 5. | Friend-Relative Support | 1.00 ns | 0.58 ns |
| 6. | Community Support | 0.79 ns | 0.96 ns |
| 7. | Material Resources | 0.35 ns | 0.84 ns |
| 8. | Perceptions Of Military Life | 0.95 ns | 0.52 ns |

There was an influence of attrition for only one outcome. For Marital Satisfaction, the "Deployed Other" group was more satisfied when they had more-than-average missing data. This finding was barely significant (nonsignificant with Bonferroni correction). Too, an attrition-controlled analysis of the earlier finding showed the same result -- deployment had no effect on change in marital satisfaction.

An Extended Model for Time

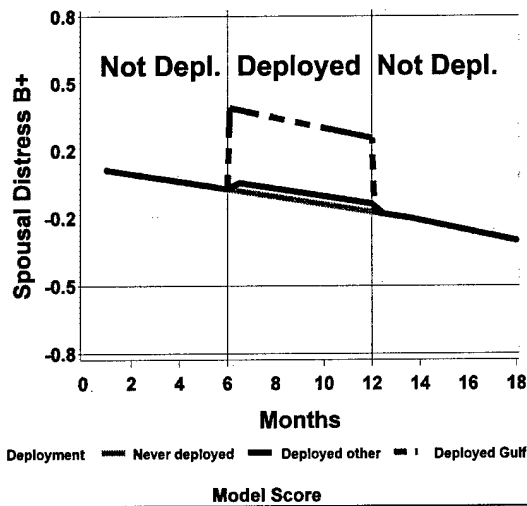
The basic longitudinal model reported above turned out surprisingly simple. This simplicity made it statistically robust and easy to interpret, but it also brought limitations. For example, deployment in the basic model was either true or false; a person either was or was not deployed (to the Gulf or other place) at any given time. This enabled the model to handle any deployment pattern, including someone with multiple deployments -- for example, they went to the Gulf in one deployment and elsewhere on another deployment. But there were no terms modeled for what happened "before deployment" or "after deployment."

To extend the model to capture health experiences before and after deployment is tricky, however. This is because, in the case of multiple deployments, the data describing health after one deployment would be the same data that describes health before the next deployment. Thus, any before and after terms would be impossible to model. Figure 9 summarizes how the simple and extended models conceptualize time and deployment. Note that the figure illustrates technical aspects of the model only, not substantive findings. As can be seen, in the simple models (A&C), the soldier is either deployed or not at any point in time, with no distinction between before and after deployment. In the extended models (B&D), the soldier's health data after one deployment would be the same health data before the next deployment. Thus, the extended model breaks down in the case of multiple deployments.

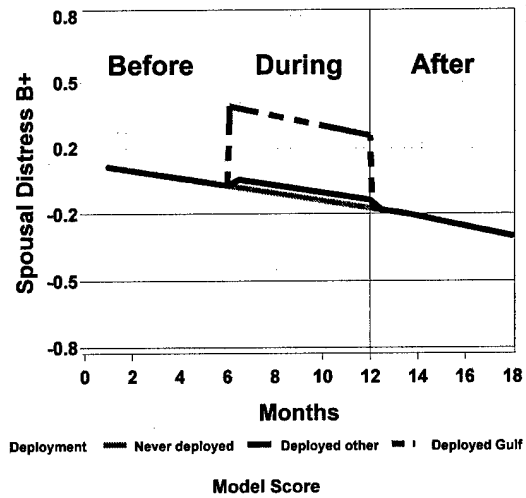
Nonetheless, a more complex model of pre- and post-deployment is possible, but only for those cases with a single deployment. Of the 565 families, 87% ($N=493$) either had zero or one deployments, a sufficient number of cases to study a more complex model of the effects of deployment.

Figure 9. Simple and Complex Models of Time

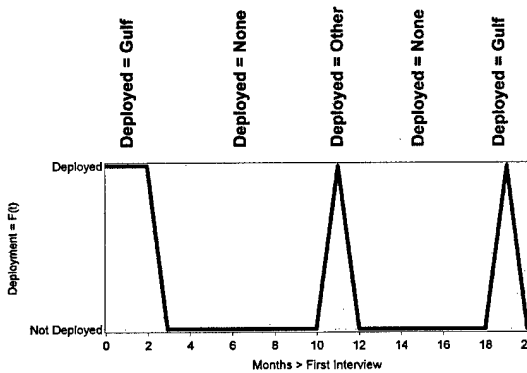
A. Simple model of time



B. More detailed model of time



C. Simple model of time



D. Extended model of time

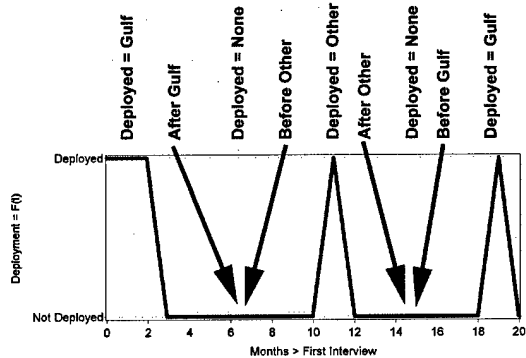
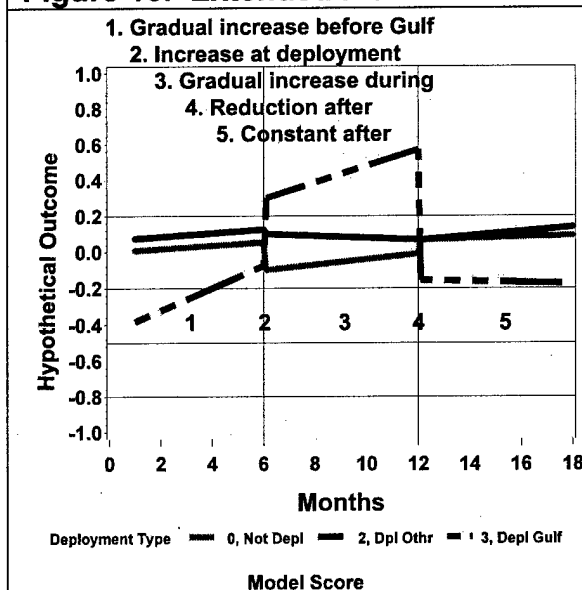


Figure 9 illustrates details of measuring time, not empirical results. Simple models of time (A and C) know only where and when the soldier is deployed; it doesn't account for before and after deployment. The more elaborate model of time (B and D) models before and after effects, but it breaks down in the case of multiple deployments because data representing the inter-deployment intervals would be the same for after one deployment and before another. For this reason the extended model is not used with multiply-deployed cases.

Figure 10 shows the extended model of time applied to a hypothetical outcome to illustrate the kinds of results that the extended model could detect. In Figure 10, there are five notes that describe the outcome for the Gulf group. There is first an increasing slope before deployment, with an increase at the onset of deployment, followed by a further increase during deployment. Then there is a short decrease at the time of return followed by a level trajectory thereafter. If these kinds of effects occur, there would be significant coefficients for the two-way interaction of time with deployment location, and the three-way interaction of pre-post by time by deployment location.

Figure 10. Extended Model of Time



Adding "before-after" and deployment location by time increases the number of differences the longitudinal HLM model can detect. The basic model included an overall slope of change with time and deployment location (not deployed, Other Deployed, Gulf Deployed). While the enhanced model could detect various time nuances, they turned out to be statistically nonsignificant.

After seeing how an extended model, at least in theory, can reveal many nuances of the soldier's health trajectory, we applied the extended model to the eight continuous HLM outcomes. Results appear in Table 11, where we see that none of the health outcomes showed significant interactions. This failure to find reliable time nuances may be a result of the model losing power as it makes the large number of estimates (19 parameters in the model) or it may simply be that families differed so much in their experiences before and after deployment that the statistical model found no common trend. The extended model with pre-deployment and post-deployment effects produced no new results to add to the results reported earlier for the simple model.

Significance tests for the two time interactions appear in Table 11 for the 8 HLM outcomes. All are nonsignificant. This failure to find reliable time nuances may be a result of the model losing power as it makes the large number of estimates (19 parameters in the model) or it may simply be that families differed so much in their experiences before and after deployment that the statistical model could find no common trend. This result suggests that the extended model with pre-deployment and post-deployment effects produced no new results to add to the results reported earlier for the simple model.

Table 11. Significance of Enhanced Time Effects

| Family Outcome | Time by Location | Time by Prepost by Location |
|---------------------------------|------------------|-----------------------------|
| Spousal Distress B+ | 0.24 ns | 0.45 ns |
| Marital Satisfaction B- | 0.93 ns | 0.79 ns |
| Family Life Events B+ | 0.72 ns | 0.05 ns |
| Family Funct Probs B+ | 0.60 ns | 0.41 ns |
| Friend-Relative Support B- | 0.96 ns | 0.98 ns |
| Community Support B- | 0.80 ns | 0.66 ns |
| Material Resources B- | 0.14 ns | 0.15 ns |
| Perceptions Of Military Life B- | 0.13 ns | 0.10 ns |

Reportable Results for Extended Model of Time

- Could model details, such as pre-Gulf or post-Gulf changes over time.
- Extended model showed no significant new effects.

More Waves of Data: Do They Change Results?

One family outcome, the FAD measure of family functioning, was available for three additional waves (a total of seven) through the Ft. Bragg Longitudinal Extension. To see if having a longer time period affected the results, we ran the longitudinal HLM model on all 7 waves of the FAD. This included follow-up measurements as much as 4 years (max = 49 months) after entry into the FBEP.

The original (4-wave) FAD analysis showed no effect of Gulf deployment. This finding is found again in the longer follow-up, as shown in Table 12. It would seem that the overall functioning of GWV families was not significantly different from others either in the short run or over the long haul.

Table 12. Extended FAD Follow-up Made No Difference

| Effect | df1 | df2 | F Value | Prob |
|--------------|-----|-----|---------|---------|
| Time | 1 | 511 | 1.96 | 0.16 ns |
| Completeness | 1 | 670 | 0.00 | 0.99 ns |
| Deployment | 2 | 670 | 0.31 | 0.73 ns |
| Deployment * | | | | |
| Completeness | 2 | 670 | 0.07 | 0.93 ns |

Moderated Effects of Deployment:

Are Highly Functioning Families Buffered from the Impact of Deployment?

A pre-stated directional hypothesis in the proposed research suggested that poorly functioning families would experience any adverse impact of Gulf deployment more than well-functioning families would. The rationale is that well-functioning families, with better communication and coping patterns, can adapt better to resist the stresses of deployment. We used the FAD as a measure of global family functioning to see whether it might moderate (or alter) the effect of deployment status on any of the other outcome measures, such as spousal distress or life events.

The results of these new analyses are shown in Table 13. As reported earlier in Table 6, family functioning is correlated with nearly every other measure of family well being, as indicated by the significance level of the correlation of the FAD with the other family measures (Column 2). Too, the two effects of deployment reported earlier, on spouse distress and life events, remain significant (Column 3). Column 4 shows that the level of family functioning does not moderate the effects of deployment on any of the other outcomes. Given the two significant main effects of deployment, this means that the negative impact Gulf deployment had on spousal distress and family life events did not depend on overall level of functioning. Apparently the effects of Gulf deployment are about the same for poorly functioning families as for well-functioning families.

Table 13. Does family functioning moderate the effects of Gulf deployment?

| | Outcome | FAD Score | Deployment | FAD by Deployment |
|----|------------------------------|-----------|------------|-------------------|
| 1. | Spousal Distress | <.0001*** | <.0001*** | 0.596 ns |
| 2. | Marital Satisfaction | <.0001*** | 0.207 ns | 0.697 ns |
| 3. | Family Life Events | <.0001*** | 0.002** | 0.856 ns |
| 4. | Friend-Relative Support | 0.245 ns | 0.190 ns | 0.933 ns |
| 5. | Community Support | <.0001*** | 0.235 ns | 0.730 ns |
| 6. | Material Resources | <.0001*** | 0.557 ns | 0.205 ns |
| 7. | Perceptions Of Military Life | <.0001*** | 0.835 ns | 0.937 ns |

Notes: FAD outcome was dropped from these FAD-moderated analyses. In these results FAD was a time-varying covariate; the pattern of results was the same when Wave 1 FAD was used as a fixed covariate indicating family functioning at entry into the study.

Are the Effects of Gulf Deployment the Same By Race and Age?

Having an analytic model for the effects of deployment on the 8 family outcomes enables us to examine whether any effects of Gulf deployment varied either by the age or race of the soldier. Table 14 shows the significance of the relationships between race (column 2) and age (column 4) with each of the eight family measures, as well as the significance of the interaction effects of deployment status with race (column 3) and age (column 5).

While results suggest that Blacks report less psychopathology among their spouses and that Hispanics report less marital satisfaction than the other ethnic groups, any effect of Gulf deployment on either spouse distress or marital satisfaction does not vary by the ethnicity of the soldier. In fact, none of the main effects of deployment on outcomes varies by ethnicity.

Results also suggest that older soldiers tend to have families with poorer functioning, but more material resources available to them than younger soldiers. But, age does not change the nature of any main effect of deployment status on either family functioning or material resources. Recall from earlier results that deployment status had no main effect on family functioning or material resources. The results here, along with these earlier results, suggest that age did not suppress or mask any main effect of deployment on either of these two outcomes.

There seem to be two significant interactions regarding deployment and age. First, while deployment status and community support were unrelated in earlier analyses of main effects, results here suggest that they may be related when age of personnel is considered. Age seems to benefit GWVs in terms of the community support older GWVs can acquire (relative to younger GWVs), while age offers less benefit to those who stay at home (not deployed), and virtually no benefit to those deployed to other, noncombat zones. Second, perceptions of military life generally become increasingly favorable with age. However, while this age effect tends to be positive among GWVs and those not deployed, the effect of age on views of the military seems to be negative among those deployed to noncombat zones (other deployed).

Table 14. Significance of Effects of Race and Age

| | Race | Race by Deploy | Age | Age by Deploy | Possibly Significant Effect |
|-----------------------------------|---------|----------------------|--------|------------------|---|
| 1. Spousal Distress B+ | 0.005** | 0.702 | 0.526 | 0.725 | Blacks report lower spousal distress |
| 2. Marital Satisfaction B- | 0.045* | 0.227 | 0.309 | 0.292 | Hispanics/Other report lower marital satisfaction |
| 3. Family Life Events B+ | 0.140 | 0.081 | 0.982 | 0.170 | |
| 4. Family Funct Probs B+ | 0.212 | 0.193 | 0.036* | 0.761 | Functioning may worsen with age (uncertain) ^a |
| 5. Friend-Relative Support B- | 0.798 | 0.855 | 0.253 | 0.155 | |
| 6. Community Support B- | 0.106 | 0.122 | 0.115 | 0.016* | Age increases support more for GWVs |
| 7. Material Resources B- | 0.383 | 0.471 | 0.010* | 0.416 | Resources are more plentiful for older families |
| 8. Perception of Military Life B- | 0.074 | 0.629 | 0.113 | 0.017* | May be negative for Other Deployed (uncertain) ^a |

Notes: ^aCoefficients not clear so results are uncertain for #4 and #8. * = $p < .05$, ** = $p < .01$.

Reportable Results for Age Race and Deployment

Related to Deployment

- Community Support increased with age more for GWVs than for others

Not related to deployment

- Blacks report lower spousal distress (better)
- Hispanic/Others report lower marital satisfaction (worse)
- Perceptions of military life get better with age

Key Research Accomplishments

| Specific Goals for Major Objectives | Completion Status |
|---|---|
| <p>I. Create database that includes all variables necessary for analyses.</p> <ul style="list-style-type: none"> ▪ Identify, download relevant disks/files from the original study ▪ Create new files, each structured appropriately for the specific analyses to be conducted (e.g., cross-sectional. Longitudinal; multilevel) ▪ Create database/file maps (e.g., complete data definition) ▪ Conduct preliminary analyses to ensure integrity of database | <div style="text-align: center;"> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> </div> |
| <p>II. Describe the <i>physical, emotional, social, and familial health</i> of GWVs and assess whether it differs appreciably from that of other era veterans.</p> <ul style="list-style-type: none"> ▪ Compute variables that summarize health status (e.g., count of problems within domains; count of problematic domains; total problem count) ▪ Run univariate and bivariate procedures on health measures; review statistics for the significance of differences between GWVs and other military groups ▪ Use multivariate techniques (e.g., regression) as needed to control for potentially confounding variables (e.g., age, ethnicity) ▪ Compare and assess statistics for the military groups to see how status of GWVs compare to the others | <div style="text-align: center;"> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> </div> |
| <p>III. Describe <i>changes in outcomes</i> and assess whether changes among GWVs differ significantly from those of other era veterans.</p> <ul style="list-style-type: none"> ▪ Use bivariate techniques to assess changes by deployment status ▪ Use multivariate longitudinal models (viz. HLM for continuous outcomes and GEE for count outcomes) to identify any discernable patterns of change (e.g., problems diminishing or increasing with time) ▪ Use multivariate models as needed to test for potential confounding variables to assess the independent effect of deployment status on changes in health outcomes ▪ Compare and assess statistics for the comparison groups to see if changes of GWVs differed from those of other groups | <div style="text-align: center;"> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> </div> |
| <p>IV. Identify subgroups of veterans (based on measures of demographic, social, and military background) who experienced either better or worse health outcomes than others, or different patterns of change in health outcomes.</p> <ul style="list-style-type: none"> ▪ Create interaction terms that specify multiplicative effects of variables (e.g., BLACK*GULF tests whether any effect of deployment is different for African Americans than for others). ▪ Run multivariate techniques to identify significant variables that distinguish between different health outcomes or different patterns of change in outcomes. ▪ Conduct additional analyses to identify other variables (e.g., age) that help explain how some background variable differentially affects health outcomes or changes in outcomes. | <div style="text-align: center;"> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> </div> |

Reportable Outcomes

This study required a statistical approach especially designed by the researchers to analyze the unique time-varying properties of the deployment data. We will pursue opportunities to share this approach and findings at a professional conference, then submit a manuscript for publication to a peer-reviewed journal.

Conclusions

This study was a secondary analysis of data on the physical, mental, social, and family health status of those military personnel who had been deployed to the Persian Gulf during Desert Storm. Their health was compared to otherwise comparable groups of active military, including those deployed to noncombat zones and those not deployed at all during the original study's data collection period (1990–1997). Information on health status was obtained at multiple points in time from 565 military personnel. The sample came from one of three military bases (Ft. Campbell, Ft. Stewart, or Ft. Bragg) that had among the highest number of troops deployed to the Persian Gulf.⁴⁰

Early results showed that the GWVs in this sample did not differ from the other active military groups on measures (e.g., age, ethnicity, rank) that have frequently been found to be relevant for studies of the effects of deployment on health status.^{10,32,33} This natural comparability between groups lends strength to this study's findings.

Analysis of differences in health status at the time of the first interview showed that GWVs were very similar to those deployed to noncombat zones and other active military who were not deployed at all. All groups were comparable in terms of the total number of physical, mental, and social problems reported as well as the frequency of specific problems associated with each of these domains. Of all the measures of physical, mental, and social health examined, only one baseline difference was significant. GWVs reported problems in more domains than the other groups. So, while their number of problems was comparable, GWVs tended to experience what problems they had in more than one area of life.

We also found that over a fourth of GWVS who had deployed to the Gulf at the time of the first interview reported having alcohol problems sometime in their lives. Notably, the reports of alcohol use among GWVs were no higher statistically than reports of those not deployed or those deployed elsewhere, and the problems were not necessarily experienced just prior to the deployment. Nonetheless, problems with alcohol are likely of high importance to the military that not only must rely on their troops' sobriety, but must also try to respond to any needs for treatment for alcohol abuse and other problems (e.g., family dissolution) that may result from such abuse.

The status of family well being is a somewhat more complicated picture. The baseline analysis showed no relationship between any of the widely used, standardized measures of family well being and deployment status. However, the longitudinal analysis did. This is likely because the longitudinal analysis is based on deployment status of all cases at all time points rather than on all cases at a single point in time (i.e., at the 1st interview only). The longitudinal results showed that the level of psychopathology (feeling lonely, feeling fearful, having trouble falling asleep, having difficulty making decisions) of the spouses of GWVs was significantly higher than that of other spouses, a finding corroborated in others' research.^{27,29}

Implications of the Study's Results

The negative impact of deployment to war zones such as the Persian Gulf on the psychological health of spouses would seem a sufficient basis for concern; but, this study's findings suggest that the significance of spousal distress extends beyond the welfare of the individual spouse. Levels of distress among spouses was highly correlated with nearly every other measure of family health and well being, suggesting that GWVs are significantly more vulnerable to less satisfying marriages, less access to critical social support from the community, fewer material resources to meet basic needs, more life events that continue to challenge families, and overall, more poorly functioning families.

Of no small importance, the distress among spouses was found to be associated with significantly more negative perceptions of life in the military and of the military itself. Coupled with the negative effect of Gulf deployment on spouse distress found in the longitudinal analyses, this suggests that spouses of GWVs are not as likely as others to believe that the military meets their families' needs or supports them with their problems or concerns. They are more likely to believe they have little control over their lives because the needs of the military conflict with theirs. GWV spouses also report that their families feel less committed than others to the overall mission of the military and that they are not as inclined to stay in the military. This can bode ill for sustaining an adequate and stable supply of troops to meet the needs of the country, particularly during an era such as now when resuming the draft finds little popular or political support.

Spouses of GWVs also report that they are less able than others to speak out about their problems or concerns without reprisal. This bodes ill for efforts, even well-intentioned efforts, of the military to respond to the special needs of families affected by deployment, particularly wartime deployment. Any special intervention or program would need to address early the reluctance these families have in coming forward to express their concerns and reveal their vulnerability.

Too, spousal distress is related to lower marital satisfaction, which might make GWVs families more susceptible to divorce and its attending problems, including poverty and emotional stress for children. Too, divorce may render some troops vulnerable as they seek alternative avenues for developing meaningful and stable relationships that marriages can often provide.

The longitudinal analysis also found that the number of stressful life events that can pile up on families was significantly greater among the GWVs families than the families of other military personnel. Other research^{15,27} has found this as well. The measure of life events includes 71 items that measure normative and non-normative, chronic and episodic, life events and changes in the family beyond those specifically about deployment (e.g., a family member lost or quit a job, a family member was married). It would seem that the families of GWVs may be less able than others to withstand even the more mundane events of daily life.

Other studies have noted that deployment precipitates a host of other changes not only for the military person but for the entire family as well, including changes in jobs, schools, friends, and family.^{16,22,23} Moreover, deployment results in one fewer adult in the home to help shoulder the responsibilities of daily living. The idea often has been that deployment generates changes that challenge the coping mechanisms of all families affected by it. Our results suggest otherwise. We find that the effect of deployment to the Gulf was unique, with accumulated negative effects for the life of the family beyond those experienced by families with someone deployed to other regions of the world. It may be that families become less fortified, less able to cope, in other aspects of life when their loved one departs for hazardous duty. This weakening of the family fiber and the stress

it places on the spouses of combat deployed troops who are left behind to manage hearth and home should be, or continue to be, a high priority for developing or expanding programs and services for families affected by combat-related deployments.

While this study finds important negative consequences of Gulf war deployment, the preponderance of nonsignificant effects corroborates findings of others who suggest that while a substantial minority of Gulf War families experienced very real difficulties, most did not experience severe systemic breakdown.²³ Nonetheless, findings underscore the critical need to address a specific area of concern, the psychological distress experienced by spouses of GWVs and, likely, by spouses of others deployed to war zones.

We also highlight that merely having supportive programs (e.g., exceptional family member programs, enrichment centers, Army community services) is likely insufficient to respond to the needs of families. Services will be more effective if they are targeted toward those who seem to be most vulnerable. Remember that we found some interaction effect between age and those deployed to the Gulf on the level of support GWVs were able to obtain from their community. Community support was greater for the older GWVs than for the younger ones. This suggests that more effort, or special efforts (e.g., information drives, mentoring) targeted toward younger families who are newer to military life are warranted.

Limitations of the Current Study and Implications for Future Research

While we think the results of this study contribute to the past literature on the health status of Gulf War veterans, we also think they can inform and guide current efforts to address the needs of families who today, with loved ones in Iraq, are in similar circumstances as those in the early 1990s. Nonetheless, we also note some weaknesses that future research might be able to better address than we were here.

A major limitation of the present study is its use of secondary analysis of data that was gathered for another purpose. While secondary analysis is cost-effective, a controlled prospective study of deployment's effects on soldiers and their families would be more likely to provide a more thorough and complete picture of the effects and possible remedies.

Measures of physical, mental, and social health were largely based on yes-no responses to whether any such type of problem occurred. Clearly, other ways of measuring these domains of health (e.g., medical examinations) are available. And while we note that research is equivocal on the superiority of more objective measures of health,¹¹ different measures may have generated results different from those found here. In short, we would be disinclined to say that the absence of significant effects of Gulf deployment on the physical, mental, and social health of the GWVs in this sample is definitive.

On the other hand, the measures of family health are very good, and it is here that we found significant outcomes related to Gulf deployments. We would strongly urge other researchers to include measures of family well being in future studies, particularly given this study's findings of the multiple linkages between spouses' emotional health and other family outcomes, including perceptions of life in the military. The need for assessments of family outcomes seems particularly warranted given the results of this study and others that find family adjustment directly influences soldiers' combat readiness, retention, and overall effectiveness.³⁰ In general, research that expands the scope of deployment-related outcomes to include such measures as family well being is needed.³

The longitudinal statistical approach used in this study was technically innovative in that it relied mainly on time-varying information, namely deployment at a given time. This statistical approach made it possible to bring together events that ran on unrelated timelines, namely the health evaluations obtained from the original FBEP and the deployment of military personnel to the Gulf. We think that once the two timelines were reconciled around common calendar time, the effects of deployment have been measured with more sensitivity than traditional between-group comparisons typically provide.

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Appendices (none)

List of Key Personnel

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